



Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

13-AMRP-0207

JUN 14 2013

Mr. D. A. Faulk, Program Manager
Office of Environmental Cleanup
Hanford Project Office
U.S. Environmental Protection Agency
309 Bradley Boulevard, Suite 115
Richland, Washington 99352

Dear Mr. Faulk:

**200-UP-1 GROUNDWATER OPERABLE UNIT REMEDIAL DESIGN/REMEDIAL ACTION
WORK PLAN, DOE/RL-2013-07, DRAFT B AND DRAFT TRI-PARTY AGREEMENT
CHANGE CONTROL FORM NUMBER M-16-13-01**

This letter responds to the U.S. Environmental Protection Agency's (EPA) April 30, 2013, comments on the 200-UP-1 Groundwater Operable Unit Remedial Design/Remedial Action Work Plan, DOE/RL-2013-07, Draft A.

The U.S. Department of Energy Richland Operations Office Responses to EPA's Comments are attached.

After a comment resolution meeting with EPA, the majority of comments were addressed and incorporated into the attached Draft B of this work plan. Outstanding comments include the remedy implementation and well installation schedule for the treatment remedy.

Draft Tri-Party Agreement Change Control Form Number M-16-13-01, to establish new milestones consistent with actions identified in the Remedial Design/Remedial Action Work Plan is also attached.

Please provide your comments by close of business on July 14, 2013.

Mr. D. A. Faulk
13-AMRP-0207

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JUN 14 2013

If you have any questions, please contact me or your staff may contact Briant Charboneau, of my staff, on (509) 373-6137.

Sincerely,

A handwritten signature in cursive script, appearing to read "Jonathan A. Dowell", followed by the word "FOR" in a simple, slightly slanted capital font.

Jonathan A. Dowell, Assistant Manager
for the River and Plateau

AMRP:NMB

Attachments

cc w/attachs:

G. Bohnee, NPT
R. Buck, Wanapum
D. Goswami, Ecology
S. Harris, CTUIR
J. A. Hedges, Ecology
S. Hudson, HAB
R. Jim, YN
E. Laija, EPA
N. M. Menard, Ecology
K. Niles, ODOE
D. Rowland, YN
Administrative Record
Environmental Portal

cc w/o attachs:

M. R. Adams, CHPRC
L. M. Dittmer, CHPRC
D. E. Dooley, CHPRC
R. H. Engelmann, CHPRC
R. A. Kaldor, MSA
T. W. Noland, MSA
R. E. Piippo, MSA
C. D. Wittreich, CHPRC

Change Number M-16-13-01	Federal Facility Agreement and Consent Order Change Control Form DRAFT	Date May 28, 2013																																				
Originator J. A. Dowell		Phone (509) 373-9971																																				
Class of Change <input type="checkbox"/> I - Signatories <input checked="" type="checkbox"/> II - Executive Manager <input type="checkbox"/> III - Project Manager																																						
Change Title Implement the actions identified in the 200-UP-1 Groundwater OU Remedial Design/Remedial Action Work Plan to implement the remedial action components identified in the 200-UP-1 ROD for Interim Remedial Action.																																						
Description/Justification of Change This change form establishes TPA Interim Milestones for the following: <ul style="list-style-type: none"> • Provide a Remedial Design Report (RDR) and a Performance Monitoring Plan (PMP) for 200-UP-1 to EPA, as required by the 200-UP-1 Remedial Design/Remedial Action Work Plan (RD/RAWP) and ROD. The RDR will be developed to provide a 90% design for implementation of the remedy, as identified in the RD/RAWP. The PMP will define the remedy performance monitoring requirements to evaluate the effectiveness of the remedial action in attaining cleanup levels. <p style="text-align: right;"><i>continued on page 2</i></p>																																						
Impact of Change This change package requires the development of several documents, well drilling and design/construction activities, and remedy performance monitoring to implement remedial action components identified in the 200-UP-1 ROD. This change package does not impact the M-016 major milestone due date.																																						
Affected Documents The Hanford Federal Facility Agreement and Consent Order, as amended, and Hanford Site internal planning, management, and budget documents (e. g., USDOE and USDOE contractor Baseline Change Control documents; Project Management Plans).																																						
Approvals <table> <tr> <td>J. A. Dowell DOE</td> <td>_____</td> <td>_____</td> <td>Approved</td> <td>_____</td> <td>Disapproved</td> </tr> <tr> <td></td> <td>Date</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>D. A. Faulk EPA</td> <td>_____</td> <td>_____</td> <td>Approved</td> <td>_____</td> <td>Disapproved</td> </tr> <tr> <td></td> <td>Date</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>N/A Ecology</td> <td>_____</td> <td>_____</td> <td>Approved</td> <td>_____</td> <td>Disapproved</td> </tr> <tr> <td></td> <td>Date</td> <td></td> <td></td> <td></td> <td></td> </tr> </table>			J. A. Dowell DOE	_____	_____	Approved	_____	Disapproved		Date					D. A. Faulk EPA	_____	_____	Approved	_____	Disapproved		Date					N/A Ecology	_____	_____	Approved	_____	Disapproved		Date				
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Description/Justification of change, continued:

- Complete the remedial design investigation of the southeast chromium plume as defined in the PMP. This includes characterizing the extent of the southeast chromium plume.
- Provide an Operations and Maintenance (O&M) Plan for 200-UP-1 to EPA, as defined in the 200-UP-1 RD/RAWP and ROD. The O&M Plan will include performance monitoring requirements for the treatment system. This milestone may be met by revising the 200 West Area P&T Facility O&M Plan to incorporate the 200-UP-1 P&T systems.
- Complete the construction of the U Plant area P&T system including any necessary wells and modifications to the 200 West Groundwater Treatment Facility to treat uranium, technetium-99 and nitrate groundwater contaminants.
- Complete the construction of the iodine-129 groundwater plume hydraulic barrier wells including any necessary modifications to the 200 West Groundwater Treatment Facility or associated transfer pump buildings.

Modifications are denoted by the use of ~~strikeout~~ to indicate text to be deleted and double underline to indicate text to be added.

<u>M-016-190</u> <u>Lead Agency: EPA</u>	<u>Submit a Draft A Remedial Design Report and Draft A Performance Monitoring Plan (PMP) for 200-UP-1 to EPA.</u>	<u>06/30/2015</u>
<u>M-016-191</u> <u>Lead Agency: EPA</u>	<u>Complete the remedial design iodine-129 groundwater plume hydraulic barrier wells.</u>	<u>8/30/2015</u>
<u>M-016-192</u> <u>Lead Agency: EPA</u>	<u>Complete the remedial design to support start of construction of the U Plant area P&T system for uranium, technetium-99 and nitrate.</u>	<u>9/30/2015</u>
<u>M-016-193</u> <u>Lead Agency: EPA</u>	<u>Complete the remedial design investigation of the southeast chromium plume.</u>	<u>9/30/2016</u>
<u>M-016-194</u> <u>Lead Agency: EPA</u>	<u>Submit a Draft A Operation and Maintenance (O&M) Plan for 200-UP-1 to EPA.</u>	<u>06/30/2016</u>
<u>M-016-195</u> <u>Lead Agency: EPA</u>	<u>Complete the construction of the U Plant area P&T system for uranium, technetium-99 and nitrate.</u>	<u>9/30/2016</u>
<u>M-016-196</u> <u>Lead Agency: EPA</u>	<u>Complete the construction of the iodine-129 hydraulic containment system.</u>	<u>9/30/2016</u>

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Design/Remedial Action Work Plan (DOE/RL-2013-07), Draft A**

General Comments

Models used during remedial design should compare the vertical and horizontal movement of contaminants (hydrostratigraphic control) and address it based on preferential controls. Past research indicated distribution of uranium and T-99 show a shallow distribution pattern and carbon tetrachloride contamination is expansive in the unconfined aquifer.

Consider the use of future rebound studies after a period of pump-and-treat activities have occurred, particularly for uranium.

Response: Accept. Rebound analysis will be addressed in the RDR and/or PMP

Specific Comments

- 1) Page 1-9, Figure 1-4: Identify all the wells which have not yet been installed and hooked up on the figure more clearly. Clarify if the 2011 carbon tetrachloride plume boundary reflects points of calculation based on concentration or some regulatory changes to the RCRA point of compliance.

Response: Accept. All extraction and injection wells, actual or planned, are shown but not distinctly. The figure will be revised by enhancing the well symbols including clearly identifying which wells have not yet been installed and hooked up. The carbon tetrachloride plume boundary is based on plume published in the CY2011 annual report. The reference will be added to the figure.

- 2) Page 2-6, Section 2.1.4: The text should include the role of the CERCLA five-year review as described in section 12.2.7 of the ROD.

Response: Accept. The CERCLA five-year review component, as discussed in ROD Section 12.2.7, will be added to this Section 2.1.4.

- 3) Page 2-10, Section 2.3, line 1: The text beginning on this page seems out of place. This section should include a title such as "Attainment of Cleanup Levels".

Response: Accept, the suggested section will be incorporated.

- 4) Page 2-11, Section 2.3, lines 21-23: The text references how statistical analysis will consist of calculating the upper one-sided 95 percent confidence limit (UCL95). However, the text does not identify which wells will be used. Clarify the sentence as follows:

"The statistical analysis will consist of calculating the upper one-sided 95 percent confidence limit (UCL95) for each COC on a well-by-well basis using a representative set of data for comparison to cleanup levels."

Response: Accept, the suggested change is appropriate for compliance monitoring and will be incorporated. Also, suggest changing "set of data" to "data set".

- 5) Page 2-12, Section 2.4: The schedule for the SAP for monitoring well installation should be included in the implementation schedule in Figure 7-1. This SAP should be considered part of the work plan.

Response: Accept, the SAP for monitoring well installation will be added to the Figure 7-1 schedule.

- 6) Page 2-13, Section 2.4.1: A SAP for the installation of injection and extraction wells should be

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mentioned here and included in the implementation schedule in Figure 7-1. This SAP should be considered part of the work plan.

Response: Accept, the SAP for extraction/injection wells for depth-discrete groundwater sampling during well drilling (as discussed in Section 3.2.1) will be added to this section and the Figure 7-1 schedule.

- 7) Page 2-13, Section 2.4.3, line 38: Revise the text as follows:

“The data will be used to calculate the UCL95 for individual COCs on a well-by-well basis and changes in plume size or concentration over time as a measure of cleanup progress.”

Response: The change is not considered to be appropriate for remediation progress monitoring. The well-by-well basis is appropriate for compliance monitoring. Suggest modifying the test as follows:

“During the active pump-and-treat period, the data will be used to calculate the UCL95 for individual COCs and changes in plume size or concentration over time as a measure of cleanup progress over each plume area.”

This spatial EPC would be consistent with the approach in the RI/FS that established baseline conditions and was used to evaluate alternatives.

- 8) Page 3-2, Section 3.1.2, lines 29: Section 3.4 is referenced when it should be 3.5. The RDR should include more than the 30 percent design. The RDR should be complete when the 90 percent design is available and should include complete design specifications, drawings, and schematics.

Response: Accept, the section referenced will be corrected as noted. The scope of the RDR will be changed to incorporate the 90 percent design for the U Plant Area P&T and Iodine-129 plume hydraulic containment systems. This will impact the RDR schedule and Figure 7-1 will be revised accordingly. This also impacts the distribution of design costs in Table 7-1. The remedial design of the southeast chromium plume area will be initiated following the completion of the southeast chromium plume characterization effort. Following completion of the southeast chromium plume design, the RDR will be revised with an addendum or other agreed to documentation.

- 9) Page 3-3, Section 3.1.2.2: Clarify if the MODFLOW/MT3DMS approach used for the 200-UP-1 OU is the same modeling approach used in the 200-ZP-1 RD/RA.

Response: The same models are used, but they have been updated and refined to provide additional detail and representativeness in the 200-UP-1 area. These models, in general, are continuously updated to meet ongoing remedial action progress evaluation on the Central Plateau. No change required.

- 10) Page 3-16, Section 3.5, lines 37-42: As mentioned in a previous comment, the RDR should be based on a 90 percent design. The 60 percent and 90 percent design should incorporate regulator input and then be documented in the RDR. This section should be revised as follows:

“The remedial design process will be performed in a phased manner (30 percent, 60 percent, and 90/100 percent designs with the latter being included in the RDR. Upon completion of the 30 percent design, EPA will be briefed on the progress of the RD and

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solicited for informal comments to be incorporated into subsequent design efforts. A briefing will also be held with EPA at approximately the 60 percent design to update progress and solicit comments to be incorporated into the 90 percent design. The RDR will be provided to the lead regulatory agency for review and approval.”

Response: Accept basing the RDR on the 90 percent design. Accept providing briefings to EPA at the 30 percent and 60 percent design phases. See response to comment 8.

- 11) Page 3-17, Figure 3-4: Identify all the wells which have not yet been installed and hooked up on the figure more clearly. Clarify why the area around ERDF is labeled as a “facility of interest.”

Response: Accept clarifying Figure 3-4 (see disposition to comment 1). The ERDF is a facility discussed in the text and is shown in the Figure accordingly.

- 12) Page 3-18, Section 3.5.1: See the previous comments regarding use of 90 percent design in the RDR. The RDR should include the 90 percent design for U Plant area, the iodine-129 plume remedies, and The characterization plan for the SE chromium plume.

Response: Accept, the scope of the RDR will be changed to incorporate the 90 percent design for the U Plant Area P&T and Iodine-129 plume hydraulic containment systems. The remedial design of the southeast chromium plume area will be initiated following the completion of the southeast chromium plume characterization effort. The characterization plan for the SE chromium plume will be defined in the PMP as described in Section 3.5.5. See response to comment 8.

- 13) Page 3-19, Section 3.5.3, line 22: Revise the text as follows:

“...and to calculate changes in the UCL95 for individual COCs on a well-by-well basis as a measure of cleanup progress.”

Response: The change is not considered to be appropriate. The well-by-well basis is used in the compliance part to demonstrate the attainment of cleanup levels (as suggested in Comment #4 above). During operations, compliance calculations cannot be made as wells could be under the influence of the remediation system. The UCL95 calculation discussed in this section for each plume area is meant to guide the optimization of the P&T system. See also comment 7.

- 14) Page 3-19, Section 3.5.3, line 34: The methodology and data for calculating the UCL95 statistic may be included in the PMP, but it should first be identified in the RDR. The PMP is likely to change over time since it is treated as a living document. Identifying the methodology and data for the UCL95 calculation in a primary document such as the RDR will ensure consistency over time in evaluating the remedy.

This section references a SAP to be contained in the PMP. Any SAPs used as part of planning for the 200-UP-1 remedy should be considered part of the work plan and/or the RDR, both of which are primary documents. No field work should be conducted until the SAPs are approved by EPA.

Response: Accept that the methodology and data set for calculating the UCL95 statistic will be identified in the RDR. Section 3.5.1 (Remedial Design Report) will be changed as follows:

- Results of recent studies and analyses as input to the design basis:
 - Groundwater modeling and plume capture analysis
 - Methodology for calculation of UCL95 on a routine basis to support remedy optimization

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- Engineering analysis to assess the need for a third technetium-99 and/or biological treatment train
- Hazard analysis
- Process influent chemistry
- Identification of long lead procurements
- Construction budget estimate
- Preliminary construction schedule.

Accept the second aspect of the comment pertaining to the SAP. The SAP will require approval by EPA before field work is performed or the PMP is issued. No change

- 15) Page 3-20, Section 3.5.4: It is not clear how and when the I-129 Technology Evaluation Plan will be developed. Clarify to what extent EPA will be briefed and solicited for input on the Evaluation Plan.

Response: Accept, EPA involvement/briefings will be clarified. DOE is currently evaluating a suite of resins, as well as, the performance of the 200 West Groundwater Treatment Facility with regard to I-129 removal efficiency. These evaluations are planned to be complete in FY14, at which time EPA will be briefed on the results. Based on these results, and in consultation with EPA, DOE will better define the scope of the I-129 Technology Evaluation Plan.

- 16) Page 3-20, Section 3.5.5, lines 15-23: The pre-1980 wells, 699-32-62 and 699-33-56, have a perforated carbon steel casing and the potential interaction with the groundwater should be considered when analyzing data from these wells. The newer 699-30-66 well with a stainless steel casing does not have the same well deficiencies.

Response: The effect of well casing materials was considered when interpreting the sample results. With regard to chromium, however, it is the stainless steel casings/screens that present more of an issue. Chromium is not a component of carbon steel but is a component of stainless steel. Other major components of stainless steel are iron, nickel, and manganese. The stainless steel casings/screens are subject to corrosion, and when this occurs, samples will yield elevated results for iron, chromium, nickel, and sometimes manganese. Chromium in 699-30-66 is currently about 120 ug/L, but iron, nickel, and manganese are mostly not detected. Chromium results are considered representative of aquifer conditions. For carbon steel wells, other parameters (e.g. vanadium) are evaluated that indicate reducing conditions are not occurring in these wells and that chromium concentrations are representative of aquifer conditions. No change.

- 17) Page 3-20, Section 3.5.5: It is not clear how and when the DQO processes will begin for additional characterization of SE chromium plume and subsequent evaluation of plume geometry. It is EPA's expectation that all wells for the remedy, including characterization and extraction/injection wells for the SE chromium plume, will be drilled during FY 2014 and FY 2015 and hooked up to the 200 West facility in FY 2016. Provide more details on the overall schedule of completion of all the characterization, extraction, and injection wells of this remedial approach and the completion of the associated groundwater transfer lines and infrastructure needed to remediate the SE

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chromium plume.

Response: The last sentence in the section says “results of the DQO process will be documented in a SAP as part of the PMP.” The SAP activity will be added to the Figure 7-1 schedule.

Extraction/injection wells will be drilled under the Remedy System Construction activities (28, 32, and 35) in Figure 7-1. This will be clarified in Section 4.3.3 Construction. With regard to monitoring wells, Figure 7-1 shows separate activities (38-42), by plume area, for drilling the monitoring wells. Line 40 will be clarified that the SE Chromium Plume wells includes the characterization wells. No change to the timing of well drilling, which is based on current DOE budget constraints. The completion of the associated groundwater transfer lines and infrastructure needed to remediate the SE chromium plume would be performed under activity 35 in Figure 7-1 and as discussed in Section 4.3.3 Construction.

- 18) Page 4-7, Section 4.5, line 9: Revise the text as follows:

“If the decrease in a contaminant concentration appears to be gradual, then the frequency of reports may be decreased to a minimum of every 5 years to correspond with the CERCLA fiveyear review.”

Response: Accept

- 19) Page 5-4, Table 5-2: ETF is listed as a disposal pathway option for liquids from sample and analysis screening. Considering there are efforts to reduce the number of waste streams going to ETF, reconsider if this is a disposal pathway that should be listed.

Response: Accept, ETF is a viable option at this time. Liquids from samples and associated chemicals/reagents can also be handled using the 200 West Groundwater Treatment Facility itself; Table 5-1 and 5-2 will be updated accordingly. Also with regard to Section 5.1.2, the last sentence should be revised as follows:

The analysis will assess the maximum incremental ambient air impact levels to ensure that the facility will not exceed WAC 173-460 small quantity emission rates at the stack or, if applicable, to ensure that the new source toxic air pollutant emission rates do not exceed WAC 173-460 acceptable source impact levels at the nearest site boundary.

- 20) Page 7-1, Section 7.1, lines 5-7: The cost estimates seem to be high. Full details and breakdown of costs will be expected in the RDR, so it is important that all costs are accurate and justifiable. For example, if the RDR is expected to cost over \$1.8 million, it should include the 90 percent design information. Revise the text as follows:

“The cost estimate for the remedial action will be included in the RDR once the design is finalized and the operational approach is described in the O&M plan. The cost estimate in the RDR will also be compared to the original estimate in the 2012 200-UP-1 ROD.”

Response: Accept, costs will be updated in the RDR which will include a 90 percent design. Accept adding that the cost estimate in the RDR will also be compared to the 200-UP-1 ROD costs. See response to comment 8.

- 21) Page 7-4, Figure 7-1: EPA is highly concerned with the remedy implementation schedule proposed in the document which would delay all well installation of the pump-and-treat remedy component

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until fiscal year (FY) 2016 through FY 2018. Remediation of groundwater at the Hanford Site is a top priority for EPA. EPA's expectation for the 200-UP-1 OU remedy is that all wells will be drilled in FY 2014 through FY 2015 and all wells will be connected to the 200 West Pump-and-Treat facility by FY 2016. Revise the implementation schedule accordingly.

The following items should be included as line items on the schedule:

- a) Completion of all remedy injection/extraction wells for all plume areas (can be listed as one item or as a separate item for each plume area) during FY 2014 and FY 2015
- b) Completion of all monitoring wells by FY 2015 (these can remain as listed under item 10 of the current schedule, but the dates must be adjusted accordingly)
- c) Connection of injection/extraction wells to the 200 West facility by FY 2016
- d) Start and completion dates for any SAPs associated with the 200-UP-1 remedy
- e) Start and completion dates for the characterization of the SE chromium plume
- f) Start and completion of the I-129 Technology Evaluation Plan including EPA review time

Response:

a, b, and c) Consistent with the response to comment 8, DOE will include the 90 percent design in the RDR, which accelerates the remedial design process into FY14/FY15 and construction into FY16 for the U Plant Area P&T and Iodine-129 plume hydraulic containment systems. The remedial design of the southeast chromium plume area will be initiated following the completion of the southeast chromium plume characterization effort. DOE cannot revise the implementation schedule further, as the schedule is based on current budget constraints. DOE understands EPA's schedule concerns and is committed to continue to work with EPA to find opportunities to accelerate the schedule.

d) The start and completion dates for any SAPs associated with the 200-UP-1 remedy will be added to the schedule.

e) The start and completion dates for the characterization of the SE chromium plume is shown by activity 40, but this will be clarified by adding "(includes characterization wells)" to the activity name.

f) EPA review time for the I-129 Technology Evaluation Plan (activity 31) will be added to the schedule.

22) The milestone change form should be revised based on the following:

- a) Submittal of the RDR should be changed so that the RDR includes the 90 percent design.
- b) The remedial design investigation for characterization of the SE chromium plume should be included in the RDR, not the PMP. The PMP is a secondary document.
- c) Characterization and remedial design/implementation for the SE chromium plume should be completed by FY 2015.
- d) All milestone dates should be changed to reflect that wells will be drilled in FY 2014 through FY 2015 and all wells will be connected to the 200 West Pump-and-Treat facility by FY 2016 (M-016-195 and M-016-196).

Response:

a) The milestone change form will be revised to show that the RDR will include a 90 percent design per response to comment 8.

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- b) The commitment to characterize the SE chromium plume is in this RDRAWP, a primary document and in proposed milestone M-016-193. No change.
- c) and d) DOE cannot accelerate the implementation schedule for the chromium plume or well drilling per response to comment 21

DOE/RL-2013-07
Draft B

200-UP-1 Groundwater Operable Unit Remedial Design/Remedial Action Work Plan

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788



P.O. Box 1600
Richland, Washington 99352

**Approved for Public Release;
Further Dissemination Unlimited**

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Draft B

200-UP-1 Groundwater Operable Unit Remedial Design/Remedial Action Work Plan

Date Published
June 2013

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

 **CH2MHILL**
Plateau Remediation Company
P.O. Box 1600
Richland, Washington 99352

APPROVED

By Shauna Adams at 1:18 pm, Jun 04, 2013

Release Approval

Date

**Approved for Public Release;
Further Dissemination Unlimited**

DOE/RL-2013-07
Draft B

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Terms

AEA	<i>Atomic Energy Act of 1954</i>
ALARA	as low as reasonably achievable
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
CAS	Chemical Abstract Services
CERCLA	<i>Comprehensive Environmental Response, Compensation, and Liability Act of 1980</i>
COC	contaminant of concern
COPC	contaminant of potential concern
D&D	decontamination and decommissioning
DOE	U.S. Department of Energy
DQO	data quality objective
DWS	drinking water standard
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
ETF	Effluent Treatment Facility
FBR	fluidized bed reactor
FS	feasibility study
FY	fiscal year
gpm	gallons per minute
HASP	health and safety plan
HDPE	high-density polyethylene
HQ	hazard quotient
HSU	hydrostratigraphic unit
IC	institutional control
IX	ion exchange
MBR	membrane bioreactor
MCL	maximum contaminant level
MNA	monitored natural attenuation
MTCA	<i>Model Toxics Control Act</i>

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N/A	not applicable
NCP	National Contingency Plan
NPL	National Priorities List
O&M	operations and maintenance
OU	operable unit
P&T	pump-and-treat
PLC	programmable logic controller
PMP	performance monitoring plan
QA	quality assurance
RAO	remedial action objective
RCRA	<i>Resource Conservation and Recovery Act of 1976</i>
RD/RA	remedial design/remedial action
RDR	remedial design report
REDOX	reduction-oxidation
RI	remedial investigation
RL	U.S. Department of Energy, Richland Operations Office
ROD	Record of Decision
S&GRP	Soil and Groundwater Remediation Project
SAP	sampling and analysis plan
SARA	<i>Superfund Amendments and Reauthorization Act of 1986</i>
SST	single-shell tank
TBD	to be determined
TMR	telescopic mesh refinement
Tri-Party Agreement	<i>Hanford Federal Facility Agreement and Consent Order</i>
TSD	treatment, storage, and disposal
UCL ₉₅	upper one-sided 95 percent confidence limit
VOC	volatile organic compound
VPAC	vapor-phase granular activated carbon
WMA	waste management area

1 Introduction

The U.S. Department of Energy's (DOE's) Hanford Site is a 1,517 km² (586 mi²) federal facility located in southeastern Washington State along the Columbia River (Figure 1-1). For administrative purposes, the Hanford Site was divided into four National Priority List (NPL) sites (Appendix B of 40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan," hereafter referred to as the "National Contingency Plan [NCP]) under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) in 1989, one of which is the 200 Areas. In anticipation of the NPL listing, the DOE, the U.S. Environmental Protection Agency (EPA), and the State of Washington (through the Washington State Department of Ecology [Ecology]) entered into the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al., 1989) in May 1989. This agreement established a procedural framework and schedule for developing, implementing, and monitoring CERCLA response actions and *Resource Conservation and Recovery Act of 1976* (RCRA) compliance and permitting, on the Hanford Site.

The 200 Area NPL site, which is commonly referred to as the Central Plateau, encompasses approximately 190 km² (75 mi²) near the center of the Hanford Site and contains multiple waste sites, contaminated facilities, and groundwater contamination plumes. The CERCLA site identification number for the 200 Areas is WA1890090078. To facilitate cleanup, these waste sites, facilities, and groundwater plumes have been grouped by geographic areas, process types, or cleanup components into several operable units (OUs).

The 200-UP-1 Groundwater OU is one of four groundwater OUs located on the Central Plateau. Each groundwater OU has its own work plan and enforceable schedule, and will eventually have its own Record of Decision (ROD) and cleanup actions as necessary. The 200-UP-1 OU (shown on Figure 1-1) consists of the groundwater beneath the southern portion of the 200 West Area. The waste sites and soil above the 200-UP-1 OU are the sources of the groundwater contamination in the OU and are (or will be) addressed as part of the cleanup of other source OUs through separate CERCLA or RCRA actions.

The DOE Richland Operations Office (RL) is the lead agency for remediation of the 200-UP-1 OU and EPA is the lead regulatory agency, as identified in Section 5.6 and Appendix C of the Tri-Party Agreement. In accordance with the Tri-Party Agreement, Article XIV, Paragraph 54, DOE developed and proposed remedial action for the 200-UP-1 OU through completion and approval of a remedial investigation/feasibility study (RI/FS) (DOE/RL-2009-122, *Remedial Investigation/Feasibility Study for the 200-UP-1 Groundwater Operable Unit*). A 30-day public comment period for the *Proposed Plan for Remediation of the 200-UP-1 Groundwater Operable Unit* (DOE/RL-2010-05) occurred from July 17 through August 16, 2012.

The selected remedy was chosen in accordance with CERCLA, as amended by the *Superfund Amendments and Reauthorization Act of 1986* (SARA), the Tri-Party Agreement, and, to the extent practicable, the NCP. This decision is based on the Administrative Record file for the 200-UP-1 OU.

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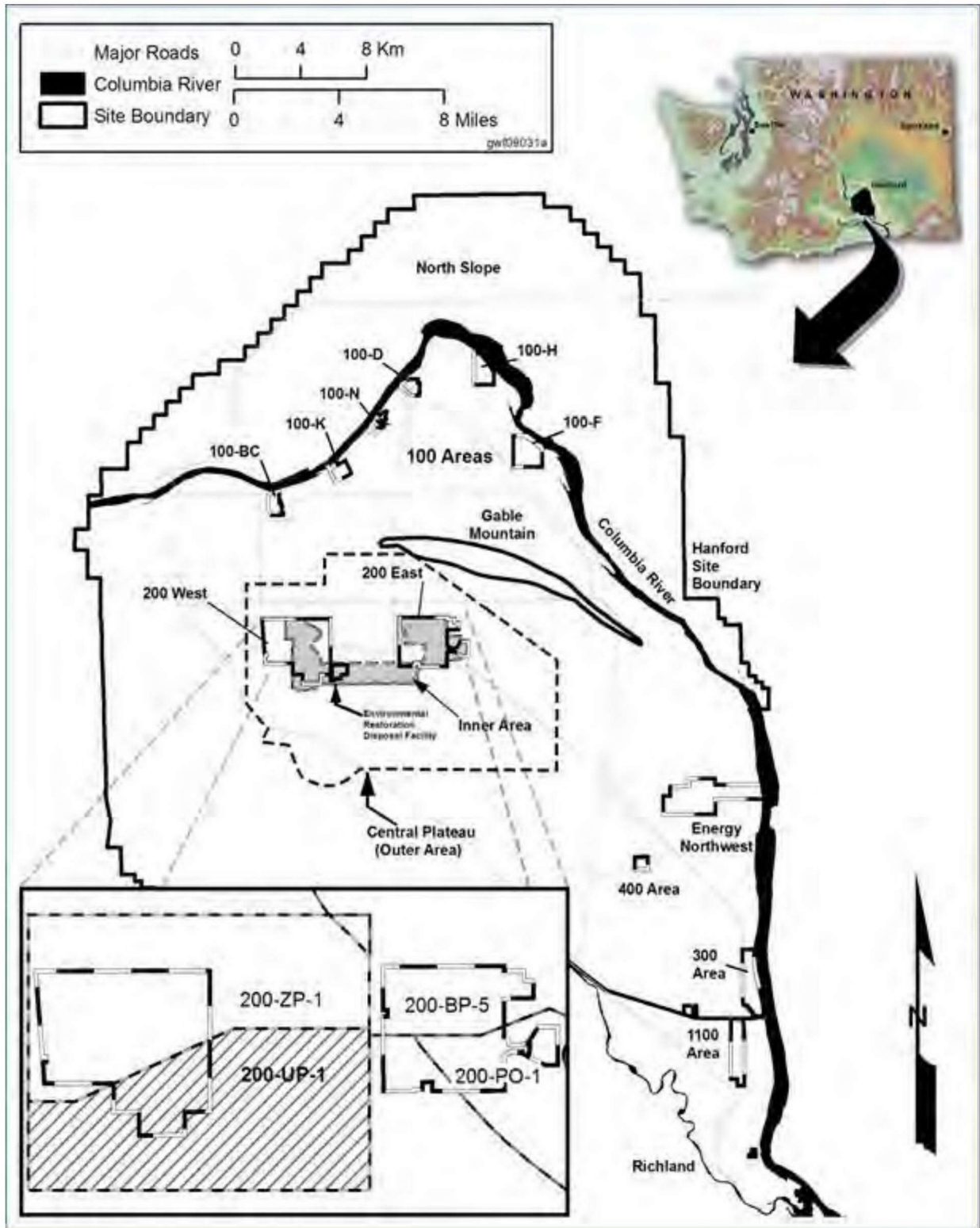


Figure 1-1. Hanford Site Map Showing the 200 West Area
and the Four Groundwater OUs Located on the Central Plateau

The *Record of Decision for Interim Remedial Action, Hanford 200 Area Superfund Site, 200-UP-1 Operable Unit* (hereafter referred to as the 200-UP-1 OU ROD) (EPA et al., 2012) was signed by EPA, DOE, and Ecology on September 27, 2012. The selected interim remedy for the 200-UP-1 OU is a combination of groundwater extraction and treatment using pump-and-treat (P&T), monitored natural attenuation (MNA), hydraulic containment of the iodine-129 plume, an iodine-129 treatment technology evaluation, remedy performance monitoring, and institutional controls (ICs). The 200-UP-1 OU ROD requires that a groundwater P&T system be designed, installed, and operated in accordance with an approved remedial design/remedial action (RD/RA) work plan. A detailed description of each component of the selected remedy is provided in Chapter 2.

1.1 Purpose

This RD/RA work plan describes how the 200-UP-1 groundwater P&T system will be designed, installed, and operated to meet the remedial action objectives (RAOs) identified in the 200-UP-1 OU ROD. In addition, requirements for implementation of MNA, hydraulic containment of the iodine-129 plume, an iodine-129 treatment technology evaluation, remedy performance monitoring, and IC requirements of the ROD are also identified in this work plan.

This RD/RA work plan is being submitted in accordance with Section 11.6 of the Tri-Party Agreement Action Plan (Ecology et al., 1989b), which states: “Within 180 days of ROD signature, or an alternative period designated in the ROD, an RD/RA work plan including schedule, along with a milestone change package, shall be submitted for lead regulatory agency review and approval” (Ecology et al., 2003).

The 200-UP-1 OU ROD (EPA et al., 2012) requires that DOE submit the RD/RA work plan, including a schedule and milestone change package, for EPA review and approval within a 270-day period after the ROD is signed.

As noted in the 200-UP-1 OU ROD and Section 7.3.10 of the Tri-Party Agreement Action Plan, the RD/RA work plan is a primary document subject to EPA approval.

1.2 Scope

This RD/RA work plan provides the plan and schedule for design, construction, operation, and monitoring activities necessary to successfully implement the remedial action selected in the 200-UP-1 OU ROD. This includes addressing the development of an operation and maintenance (O&M) plan and a performance monitoring plan (PMP). The selected interim remedy for the 200-UP-1 OU addresses the following contaminants of concern (COCs): carbon tetrachloride, chromium (total and hexavalent), nitrate, uranium, technetium-99, iodine-129, and tritium.

Groundwater P&T will be used to capture contaminated groundwater to reduce the levels of uranium, technetium-99, total and hexavalent chromium, carbon tetrachloride, and nitrate. Treatment of extracted groundwater will be performed at the 200 West Groundwater Treatment Facility. The iodine-129 plume will be hydraulically contained using groundwater injection. Lower concentration areas of the nitrate and carbon tetrachloride plumes, and the entire tritium plume, will be addressed using MNA. ICs will be used to restrict access to, and use of groundwater until cleanup levels for unrestricted use are achieved.

The waste sites and soil above the 200-UP-1 OU are the primary sources of the groundwater contamination and are being addressed under RCRA or as part of other 200 Area OUs that are following the CERCLA RI/FS process; therefore, these waste sites and soil are not within the scope of this RD/RA work plan. Remedial action decisions for contaminant sources and associated vadose zone contamination will be made under separate OU RODs. This RD/RA work plan implements the interim remedial action selected in the 200-UP-1 OU ROD, addressing contamination that has already reached

groundwater. A final ROD for the 200-UP-1 OU will be pursued when future impacts to groundwater from contaminant sources or vadose zone contributions are more fully understood, and when the iodine-129 treatment technology evaluation has been completed.

1.3 Site Description and Background

The 200-UP-1 OU includes several groundwater contamination plumes that cover an area of approximately 10 km² (4 mi²) beneath part of the 200 West Area (discussed in Section 1.3.2). The 200 West Area is approximately 8 km² (3 mi²) in size and is located near the middle of the Hanford Site (Figure 1-1). This OU is approximately 8 km (5 mi) south of the Columbia River and 11 km (7 mi) from the nearest Hanford Site boundary. The 200 West Area is located on an elevated, flat area that is often referred to as the Central Plateau, and there are no wetlands, perennial streams, or floodplains present.

The 200 West Area contains waste management facilities and former irradiated fuel reprocessing facilities that have been grouped into four process areas: U Plant, Z Plant, S Plant (Reduction-Oxidation [REDOX] Plant), and T Plant. The major waste streams that contributed to 200-UP-1 OU groundwater contamination were associated with the plutonium-separation and uranium recovery operations at the S Plant and U Plant facilities, where liquid wastes were disposed to the ground via ponds, cribs, ditches, and trenches. As effluent was discharged to these sites in the past, the more mobile contaminants migrated through the vadose zone to the groundwater. Some groundwater contamination also resulted from single-shell tank (SST) leaks or unplanned releases, particularly associated with Waste Management Area (WMA) S-SX. In addition, groundwater contamination has migrated from the adjacent 200-ZP-1 OU into the 200-UP-1 OU that originated from liquid waste disposed to the ground at Z Plant plutonium concentration and recovery facilities.

The following subsections briefly describe the site setting, and the nature and extent of contamination within the 200-UP-1 OU; ongoing 200 West Area remedial actions; and ongoing groundwater monitoring. More detailed information describing the Hanford Site, the 200 West Area, and the 200-UP-1 OU is provided in the RI/FS report (DOE/RL-2009-122) and the 200-UP-1 OU ROD (EPA et al., 2012).

1.3.1 Physical Setting

The Hanford Site lies within the semiarid, shrub-steppe Pasco Basin of the Columbia Plateau in southeastern Washington State (Figure 1-1). The 200 Areas are located on a broad, relatively flat area that constitutes a local topographic high near the center of the Hanford Site. The 200-UP-1 OU underlies the southern portion of the 200 West Area, which is on the western end of the Central Plateau. Surface elevations above the OU range from approximately 183 m (600 ft) to more than 213 m (700 ft) above mean sea level.

Basalt of the Columbia River Basalt Group and a sequence of overlying sediments comprise the local geology. The overlying sediments are approximately 169 m (555 ft) thick and primarily consist of the Ringold Formation and Hanford formation, which are composed primarily of sand and gravel, with some silt layers. Figure 1-2 shows a generalized cross section of the Central Plateau and illustrates the hydrogeologic conditions present at the OU, including the water table. Geologic units above the basalt bedrock (in descending sequence) are as follows:

- Unconsolidated sand and gravel of the Hanford formation (HSU 1)
- Fine- to coarse-grained sediment of the Cold Creek unit (HSU 3)
- Semiconsolidated silt, sand, and gravel of the Ringold Formation unit 5 (HSU 5)

- Silt and clay of the Ringold Formation lower mud unit 8 (HSU 8)
 - Semiconsolidated silt, sand, and gravel of the Ringold Formation unit 9 (HSU 9)
- These sedimentary layers are laterally continuous across the majority of the OU and are referred to as hydrostratigraphic units (HSUs). Sediments in the vadose zone are the Ringold Formation (the uppermost Ringold unit E and the upper Ringold unit), the Cold Creek unit, and the Hanford formation.
- Groundwater beneath the Hanford Site is found in an upper primarily unconfined aquifer system and in deeper confined aquifers within the lower Ringold Formation and the basalt. Groundwater in the unconfined aquifer flows from areas where the water table is higher (west of the Hanford Site) to areas where it is lower (the Columbia River). In general, groundwater flow through the Central Plateau occurs in a predominantly easterly direction from the 200 West Area to the 200 East Area (Figure 1-2).

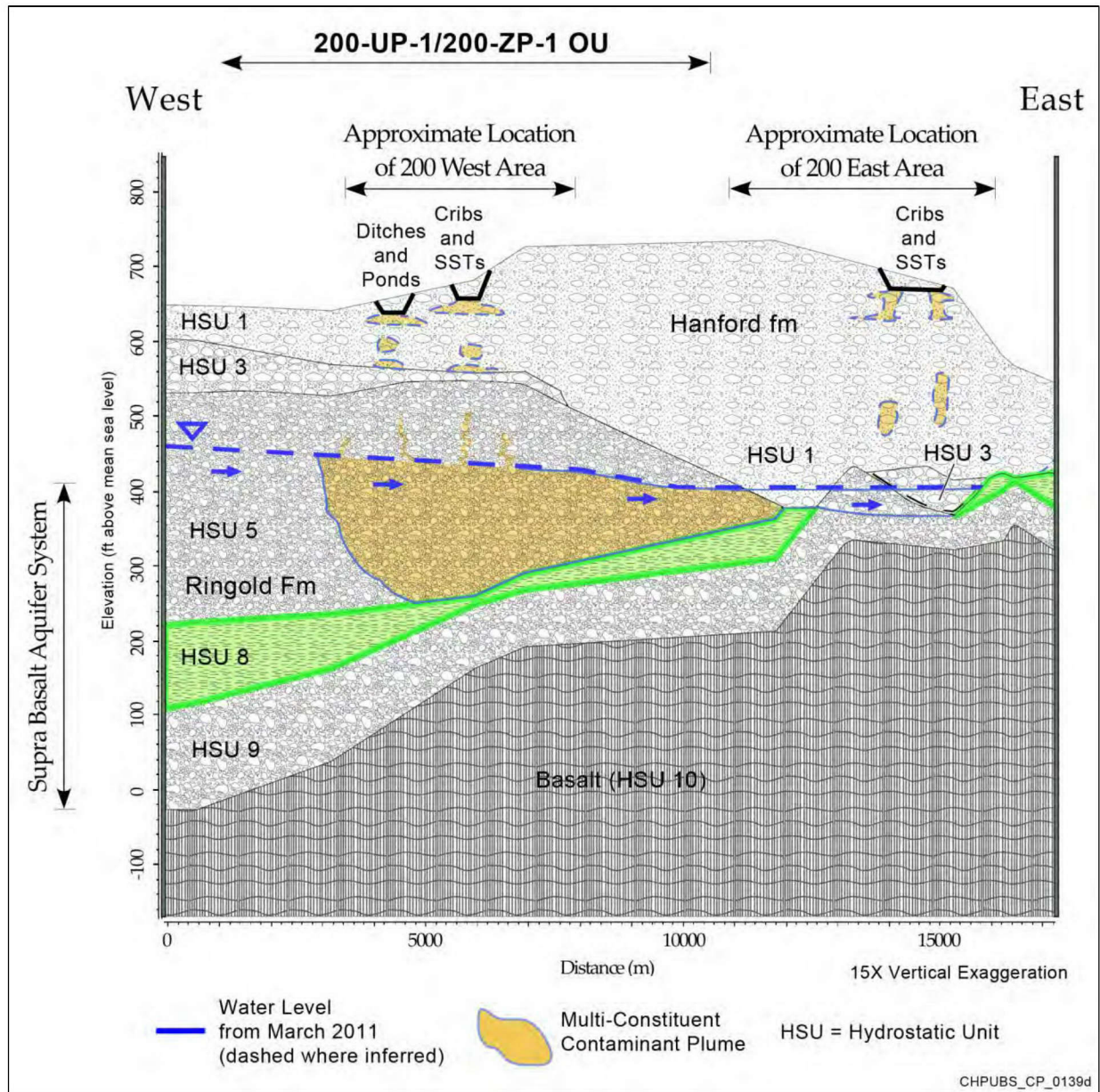


Figure 1-2. Conceptual Physical Site Model for the 200 West Area

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Historical liquid waste discharges to the ground (e.g., cooling water and process wastewater) during the 1940s through the 1990s greatly altered the groundwater flow regime, especially around the 216-U-10 Pond in the 200 West Area, which created a large water table mound that deflected the groundwater flow to the northeast. As drainage from these discharges has ceased, the water table has been declining, and groundwater flow direction is returning to a more easterly course through the Central Plateau. There are currently no liquid waste discharges to the ground above the 200-UP-1 OU (with the exception of sanitary drain fields).

The water table is relatively deep within the 200-UP-1 OU, averaging approximately 75 m (250 ft) below ground surface (bgs). Groundwater contamination is largely contained within the uppermost unconfined aquifer, which ranges in thickness from approximately 10 to 100 m (33 to 330 ft). The unconfined aquifer controls the lateral movement of groundwater contaminants across the OU and is bounded below by the Ringold Formation lower mud unit (HSU 8). This mud layer acts as a hydraulic impediment over the majority of the OU and limits groundwater flow from moving into the confined aquifer below. Groundwater flow is locally influenced by the 200-ZP-1 OU final remedy P&T system and the WMA S-SX interim remedial measure extraction system.

1.3.2 Nature and Extent of Contamination

In the 200-UP-1 OU, the COCs are carbon tetrachloride, uranium, nitrate, chromium (total and hexavalent), iodine-129, technetium-99, and tritium. Figure 1-3 shows the 200-UP-1 OU groundwater plumes (location and size) based on *Hanford Site Groundwater Monitoring for 2011* (DOE/RL-2011-118). More than 90 groundwater monitoring wells were used to assess the nature and extent of these contaminants within and surrounding the 200-UP-1 OU. The 200-ZP-1 OU plumes to the north are also shown on Figure 1-3. The plumes originating within the 200-UP-1 OU include the following:

- A uranium plume originating from the U Plant cribs
- A widespread nitrate plume originating from U Plant and S Plant cribs and WMA S-SX
- A chromium (total and hexavalent) plume associated with WMA S-SX, and a dispersed chromium (total and hexavalent) plume in the southeast corner of the OU that originated from an S Plant crib
- A widespread iodine-129 plume originating from U Plant and S Plant cribs
- Four separate technetium-99 plumes associated with WMA U, U Plant cribs, and WMA S-SX
- A widespread tritium plume originating from S Plant cribs

In addition to the plumes that formed within the 200-UP-1 OU, a widespread carbon tetrachloride plume exists over a large portion of the 200 West Area. This plume originated from operation of the Plutonium Finishing Plant (Z Plant) facilities and has spread south and east from the 200-ZP-1 OU and into the 200-UP-1 OU. Additional information on the extent of contamination, including cross-section illustrations, is provided in Appendix A.

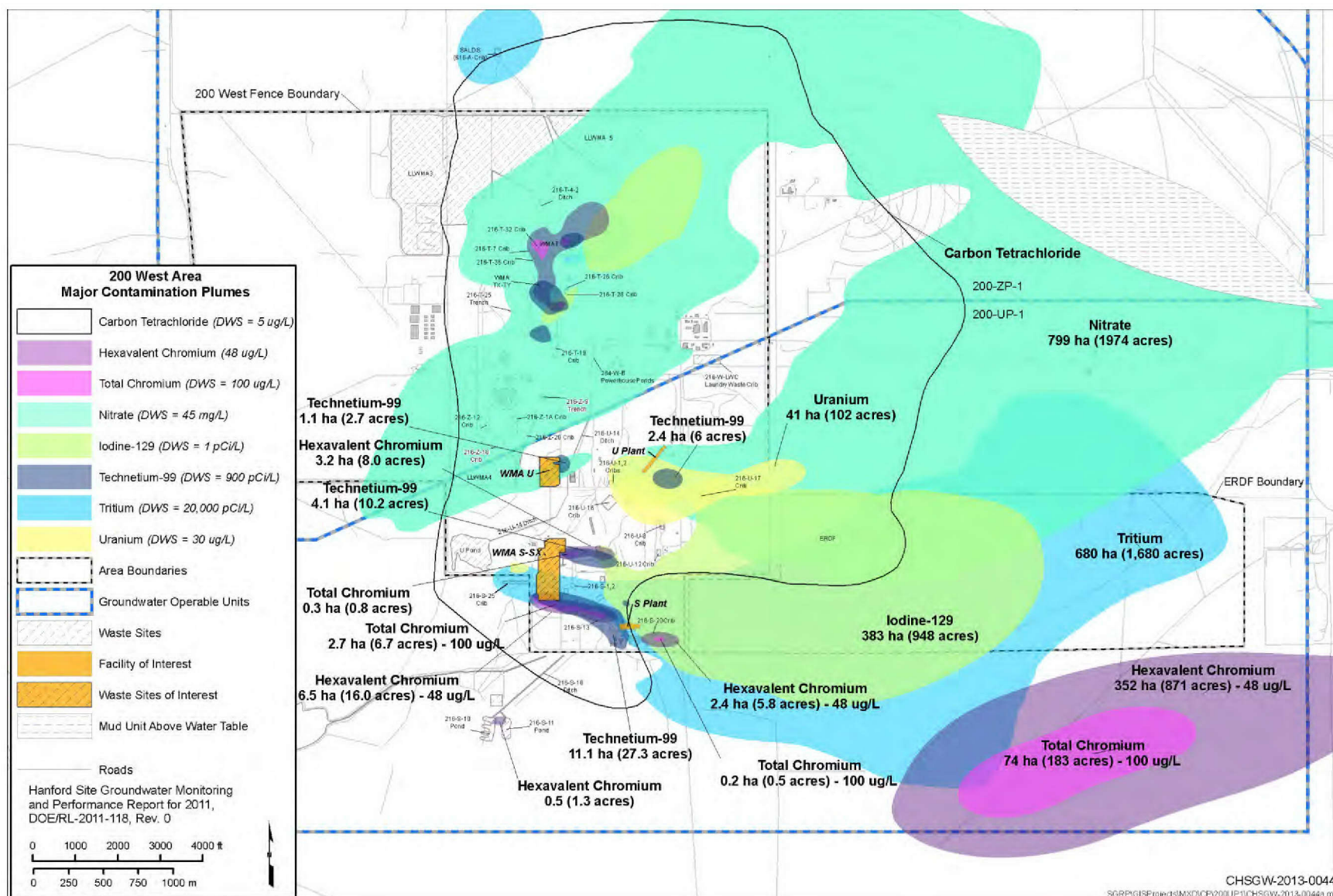


Figure 1-3. 200 West Area Groundwater Plume Map (200-UP-1 and 200-ZP-1 OUs)

1.3.3 200-ZP-1 Operable Unit Final Remedy

The *Record of Decision Hanford 200 Area 200-ZP-1 Superfund Site, Benton County, Washington* (EPA et al., 2008) was issued in 2008 and identifies the use of P&T, MNA, and ICs to remediate contaminated groundwater and prevent exposure during remediation. The P&T system, referred to as the 200 West P&T, consists of extraction and injection wells, aboveground pipelines, transfer stations, and the 200 West Groundwater Treatment Facility (Figure 1-4) to treat the COCs (carbon tetrachloride, trichloroethene, nitrate, total chromium, hexavalent chromium, and technetium-99) using various chemical, physical, and biological treatment processes. The P&T operations began in 2012. Treatment facility operations consist of two main processes: (1) a radiological pretreatment process using ion exchange (IX) for groundwater containing technetium-99; and (2) a central treatment process that uses anoxic and aerobic biodegradation for nitrate, metals and organic contaminants, membrane filtration for removal of particulate matter, and air stripping for removal of volatile organic compounds (VOCs). The treated effluent is returned to the aquifer using vertical injection wells. This facility will also be used to treat groundwater extracted from the 200-UP-1 OU, with appropriate modifications.

The 200 West P&T is designed to extract, treat, and reinject groundwater at up to 9,463.5 L/min (2,500 gallons per minute [gpm]). The system is expected to have a significant local effect on groundwater flow dynamics in and around the 200 West Area and further reduce the levels of carbon tetrachloride present and migrating toward the 200-UP-1 OU.

1.3.4 200-UP-1 Operable Unit, WMA S-SX Interim Extraction System

A groundwater extraction system at WMA S-SX was implemented under the *200-UP-1 Groundwater Remedial Design/Remedial Action Work Plan* (DOE/RL-97-36, Rev. 3) and the *Interim Remedial Action Record of Decision for the 200-UP-1 Operable Unit, Hanford Site, Benton County, Washington* (EPA/ROD/R10-97/048) as an interim remedial action to reduce technetium-99 to below 10 times the maximum contaminant level (MCL) of 900 pCi/L. The design consists of a three-well extraction system, aboveground pipelines, and a transfer building to pump extracted groundwater at a nominal rate of 300 L/min (80 gpm) to the 200 West Groundwater Treatment Facility for treatment and reinjection.

The WMA S-SX extraction system with treatment through the 200 West Groundwater Treatment Facility began operations in 2012 and will continue as a component of the 200-UP-1 OU P&T system under this RD/RA work plan, with the more stringent goal of reducing contaminant levels to below MCLs. The 200-UP-1 OU ROD issued in 2012 supersedes all previous remedy decisions for this OU.

1.3.5 Groundwater Monitoring at the 200-UP-1 Operable Unit

Groundwater monitoring for the 200-UP-1 OU is performed under CERCLA and the *Atomic Energy Act of 1954* (AEA). Details of the current monitoring program are specified in the monitoring schedule provided in Appendix B. This monitoring schedule will be replaced with a new remedy PMP, as discussed in Section 2.4. Within the OU, groundwater monitoring is also performed under RCRA for three treatment, storage, or disposal (TSD) units: the WMA S-SX Tank Farms, the WMA U Tank Farm, and the 216-S-10 Pond and Ditch. Monitoring under CERCLA is also performed at the Environmental Restoration Disposal Facility (ERDF). Data for facility-specific monitoring are also integrated into the 200-UP-1 OU groundwater monitoring program.

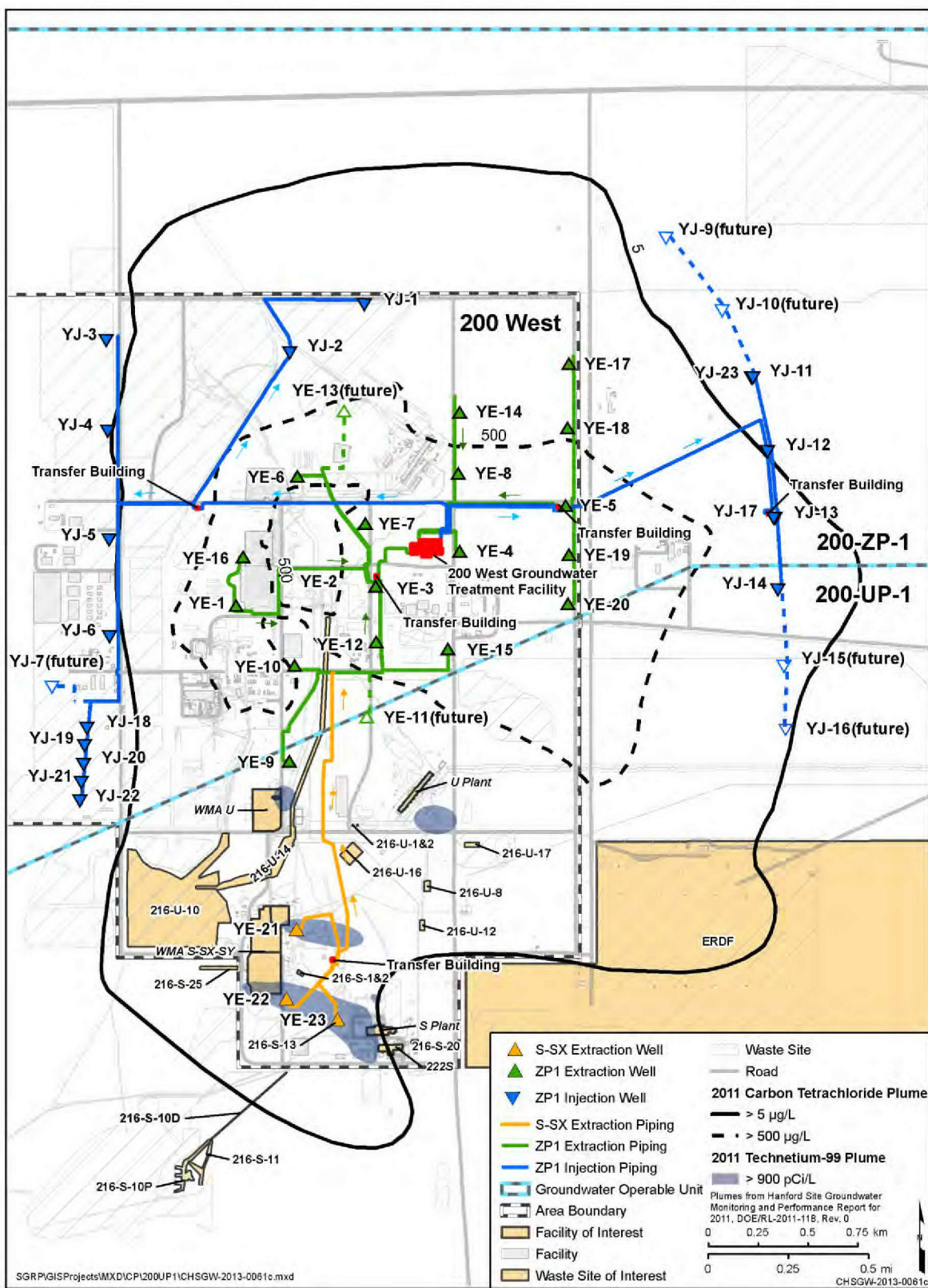


Figure 1-4. 200 West P&T, Including Locations of the 200 West Groundwater Treatment Facility, and Extraction and Injection Well Systems

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Groundwater at both WMA S-SX and WMA U is monitored under RCRA interim status groundwater quality assessment requirements (40 CFR 265.93[d], “Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities,” “Preparation, Evaluation, and Response,” as referenced by WAC 173-303-400, “Dangerous Waste Regulations,” “Interim Status Facility Standards”). Details of the interim status groundwater monitoring are provided in *Interim Status Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area S-SX* (DOE/RL-2009-73, Rev. 0) and *Interim Status Groundwater Quality Assessment Plan for the Single-Shell Tank Waste Management Area U* (DOE/RL-2009-74, Rev. 1). The objective for groundwater quality assessment is to determine the extent and rate of movement in groundwater of constituents originating from the WMA. The dangerous waste constituent chromium (as well as the supporting constituent nitrate) is monitored at both tank farms. Technetium-99 is the major radioactive constituent originating from the tank farms and is monitored under CERCLA/AEA.

Groundwater at the 216-S-10 Pond and Ditch is monitored under RCRA interim status indicator evaluation requirements (40 CFR 265.93[b], as referenced by WAC 173-303-400). Details of the monitoring program are presented in *Interim Status Groundwater Monitoring Plan for the 216-S-10 Pond and Ditch* (DOE/RL-2008-61, Rev. 0). This monitoring is conducted to determine if the 216-S-10 Pond and Ditch have impacted groundwater with dangerous waste constituents. Samples are collected for RCRA indicator and site-specific parameters.

Groundwater monitoring at the ERDF is regulated under a CERCLA ROD (EPA/ROD/R10-95/100, *EPA Superfund Record of Decision: Hanford 200-Area [USDOE] Hanford Environmental Restoration Disposal Facility, Hanford Site, Benton County, Washington*), which states that groundwater monitoring shall be conducted in accordance with RCRA regulations. The site was designed to meet RCRA standards, although it is not actually permitted as a RCRA facility. The monitoring plan for the ERDF is presented in the *Groundwater Protection Plan for the Environmental Restoration Disposal Facility* (WCH-198).

1.4 200-UP-1 and 200-ZP-1 Operable Unit Integration

The 200-UP-1 and 200-ZP-1 OUs are physically adjacent to one another, will share a common treatment facility, have similar COCs and cleanup levels (200-UP-1 OU adds uranium as a COC requiring treatment), and have a similar remediation strategy that uses P&T in combination with flow-path control and MNA. The 200 West P&T is designed to extract and reinject up to 9,463.5 L/min (2,500 gpm) of groundwater that will have hydrological impacts on the 200-UP-1 OU. As a result, implementation of the 200-UP-1 OU remedy will require close integration with 200-ZP-1 OU remedial actions. Areas of integration include the following:

- Common treatment facility will require common treatment O&M and waste management plans
- Shared transfer buildings
- Remedial design must consider the hydrological stresses imposed on the aquifer from the 200 West P&T
- Groundwater monitoring to support a cost-effective monitoring program and avoid duplication of effort
- Annual reporting

Additional discussion on these areas of integration is provided in subsequent sections of this work plan.

2 Basis for Remedial Action

The NCP (40 CFR 300.430[a][1][iii][F]) states that EPA expects to return usable groundwater to beneficial use wherever practicable, within a time frame that is reasonable given the particular circumstances of the site. The state of Washington defines groundwater as potable in WAC 173-340-720(2) (“Model Toxics Control Act–Cleanup,” “Groundwater Cleanup Standards”), unless the exclusion criteria in WAC 173-340-720(2)(a) through (c) can be demonstrated (e.g., insufficient yield or natural constituents that make it unsuitable as a drinking water source). The groundwater beneath the Central Plateau within the 200-UP-1 OU does not meet the exclusion criteria; therefore, it is classified by the Washington State as potable. The state of Washington has further determined that the highest beneficial use for potable groundwater, including potable groundwater at the Hanford Site, is as a potential source of domestic drinking water (WAC 173-340-720[1][a]).

Based on anticipated yield and natural water quality, under EPA’s groundwater classification program, the 200-UP-1 OU groundwater would be designated Class IIB groundwater, which is a potential source of drinking water. This is also consistent with the state of Washington’s determination that the 200-UP-1 OU groundwater meets the WAC 173-340-720 definition for potable groundwater, which is the highest recognized beneficial use.

Groundwater from the 200-UP-1 OU is contaminated and is not currently withdrawn from the aquifer for beneficial use; however, the potential beneficial use of the groundwater is as a drinking water source. The results of the risk evaluation performed for the OU (DOE/RL-2009-122) indicate that there are significant risks associated with the domestic use of the groundwater that exceeds acceptable risk thresholds. However, there are no current risks to onsite industrial workers or offsite human receptors from the contaminated groundwater because the existing Hanford Site access restrictions and ICs prevent groundwater use and therefore exposure. Consistent with the beneficial-use classifications of Washington State and EPA, the goal for remediating 200-UP-1 OU groundwater is to reduce contamination to levels that will allow its use as a future drinking water source.

The 200-UP-1 OU ROD (EPA et al., 2012) states that the selected response action is necessary to protect the public health, welfare, or the environment from actual or threatened releases of hazardous substances, pollutants, or contaminants into the environment. Such a release or the threat of release may present an imminent and substantial endangerment to public health, welfare, or the environment.

2.1 Selected Remedy

A description and analysis of possible alternatives for remediating the 200-UP-1 OU are presented in Chapters 9 and 10 of the 200-UP-1 OU ROD (EPA et al., 2012), and in Chapter 9 of the RI/FS report (DOE/RL-2009-122). As part of the evaluation of alternatives, several key factors influenced the choice of the selected remedy in the ROD, including the following:

- The expectation that the aquifer will be restored to its highest beneficial use as a potential drinking water source.
- The overall time to return the aquifer to beneficial use was the same for all alternatives based on the time required to achieve the drinking water standard (DWS) for carbon tetrachloride (125 years). This is consistent with the time frame identified in the ROD for achieving the DWS for carbon tetrachloride in the adjacent 200-ZP-1 OU.
- More aggressive pumping of contaminated groundwater does not reduce the overall time required to restore the aquifer.

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- More aggressive pumping of nitrate contaminated groundwater adds additional operational complexity, increases the amount of solid material handling, dewatering and onsite disposal, and does not shorten the overall remedial time frame.

The ROD concluded that the selected remedy for the 200-UP-1 OU is protective of human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action (or satisfies requirements for a waiver), and is cost effective. The selected remedy also uses permanent solutions and alternative treatment technologies to the maximum extent practicable. The remedy for this OU satisfies the statutory preference for treatment as a principal element through the use of P&T technology to remove and treat contaminated groundwater, which permanently and significantly reduces the toxicity, mobility, and volume of hazardous substances, pollutants, or contaminants.

The selected remedy combines groundwater P&T for parts of the carbon tetrachloride plume, technetium-99 plumes, uranium plume, high-concentration nitrate plume area, and chromium (total and hexavalent) plumes, with hydraulic containment of the iodine-129 plume. The remedy is expected to achieve cleanup levels for technetium-99 within 15 years, for uranium within 25 years, for chromium (total and hexavalent) within 25 years, and for nitrate within 35 years through P&T and MNA. MNA is selected for the tritium plume, which is expected to achieve cleanup levels within 25 years. A total duration of approximately 125 years (including active restoration and MNA) is anticipated for carbon tetrachloride to reach the cleanup level, which is consistent with the cleanup time frame for carbon tetrachloride in the adjacent 200-ZP-1 OU. ICs will prevent exposure and groundwater use until cleanup levels are achieved.

The selected remedy includes a waiver of the federal DWS of 1 pCi/L for iodine-129, which is an applicable or relevant and appropriate requirement (ARAR). The ROD provides for an interim remedial action that will only be a part of the total remedial action for the 200-UP-1 OU and that will attain or otherwise waive the ARAR for iodine-129 upon completion of remedial action, as required by CERCLA Section 121(d)(4), "Cleanup Standards," "Degree of Cleanup." A subsequent ROD will be needed to complete the total remedial action for the 200-UP-1 OU. In the event that a viable treatment technology is not available, the use of a technical impracticability waiver under 40 CFR 300.430(f)(1)(ii)(c) may need to be considered as part of the final remedy.

Treatment of extracted groundwater will occur at the 200 West Groundwater Treatment Facility. Modifications to the 200 West Groundwater Treatment Facility will be required to accommodate the additional flow and contaminant concentrations, including the installation of an IX treatment train to treat uranium. Other modifications, to be determined during design, may include an additional technetium-99 IX treatment train and a biological process treatment train.

The expected outcome of the selected remedy is the return of 200-UP-1 OU groundwater to a level that allows for its use as a source of drinking water within 35 years for all COCs, except iodine-129 and carbon tetrachloride. It will take up to 125 years to achieve the cleanup level for carbon tetrachloride contamination. The expected outcome for the iodine-129 plume is hydraulic containment.

The major components of the 200-UP-1 OU remedial action are further discussed in the following subsections.

2.1.1 Groundwater Extraction and Treatment Component

A major component of the 200-UP-1 OU remedy is the design, installation, and operation of a groundwater P&T system that will be implemented in combination with MNA to achieve cleanup levels for all COCs in 125 years, except for iodine-129. The P&T system will be designed to capture and treat

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contaminated groundwater to reduce the levels of uranium, technetium-99, total and hexavalent chromium, carbon tetrachloride, and nitrate. Extraction wells will be designed, installed, and operated to remove contaminated groundwater from the aquifer and to reduce or control further plume migration. Injection wells will be used to return treated groundwater back into the aquifer and to provide groundwater flow-path (gradient) control or hydraulic containment.

The total extraction rate estimated in the RI/FS report is 1,628 L/min (430 gpm). The estimated number of extraction and injection wells, pumping rates, and pumping duration (by plume area) are as follows:

- **WMA S-SX area (technetium-99, carbon tetrachloride and chromium):** Three extraction wells with a total average extraction rate of 303 L/min (80 gpm) for 15 years. This is a continuation of the existing interim action extraction system at WMA S-SX, which began operations in 2012.
- **U Plant area (uranium, technetium-99, carbon tetrachloride and nitrate):** Two extraction wells and two injection wells operating with a total average rate of 568 L/min (150 gpm) for 25 years.
- **Southeast chromium plume area:** Two extraction wells and two injection wells operating with a total average extraction rate of 757 L/min (200 gpm) for 25 years.

A conceptual layout of the P&T system, taken from the 200-UP-1 OU ROD, is illustrated on Figure 2-1, which also includes the current groundwater plumes.

Extracted groundwater will be pumped to the 200 West Groundwater Treatment Facility for treatment using aboveground pipelines and transfer buildings as needed. The treatment facility includes various chemical, physical, and biological treatment processes designed specifically to treat the COCs (carbon tetrachloride, nitrate, total and hexavalent chromium, and technetium-99). The facility consists of two main processes, including a separate radiological pre-treatment process using IX resins, and a central treatment process that uses anoxic and aerobic biodegradation for nitrate, metals and organic contaminants, membrane filtration for removal of particulate matter, and air stripping for removal of VOCs.

Modifications to the 200 West Groundwater Treatment Facility will require the addition of an IX treatment train to remove uranium. Other modifications to reach effluent requirements may include a third technetium-99 IX treatment train and a third biological process treatment train. The additional capacity to accommodate 200-UP-1 OU flows and the space needed for equipment modifications have already been designed into the facility's footprint. Extracted groundwater containing radionuclides (WMA S-SX and U Plant plume areas) will be treated first through the radiological treatment trains, as needed. Extracted groundwater that does not contain radionuclides requiring treatment (southeast chromium plume area) will bypass the radiological treatment process. A conceptual layout for the treatment process is illustrated on Figure 2-2. The COCs in groundwater will be treated to achieve the cleanup levels (as defined in Table 14 of the ROD and Section 2.3 of this RD/RA work plan) before being returned to the aquifer through injection wells.

Design requirements, specific extraction and injection well locations, pumping rates, treatment equipment design, transfer building needs, operational requirements, and other system details will be determined during the remedial design phase and will be documented in the remedial design report (RDR) or O&M plan, where appropriate, which are subject to review and approval by EPA. The remedial design process is discussed in Chapter 3. Input to the remedial design will include information gathered through the installation of wells, as well as from experience gained from installation and operation of the 200 West P&T.

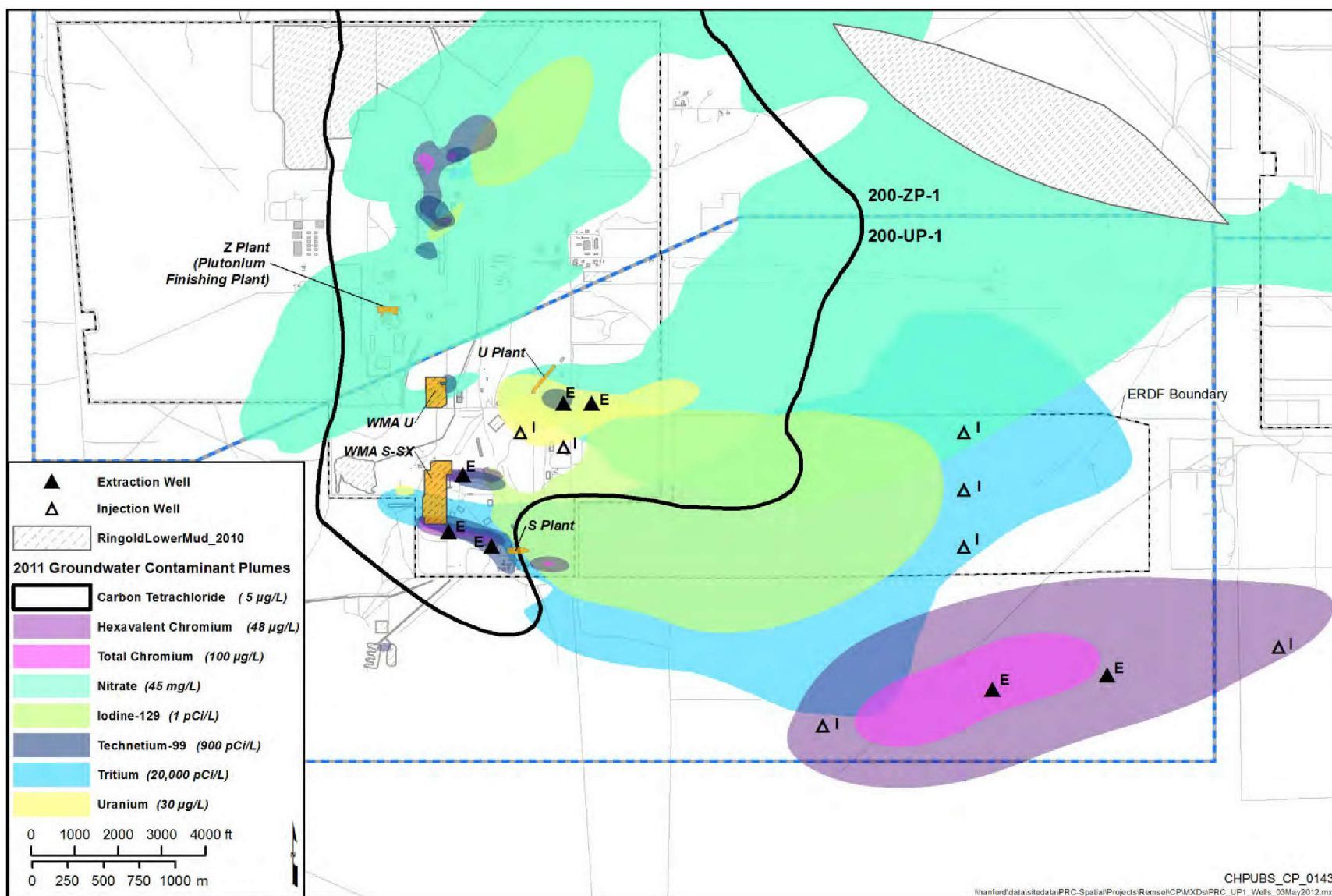


Figure 2-1. Conceptual Layout of Extraction and Injection Wells for the 200-UP-1 Remedy

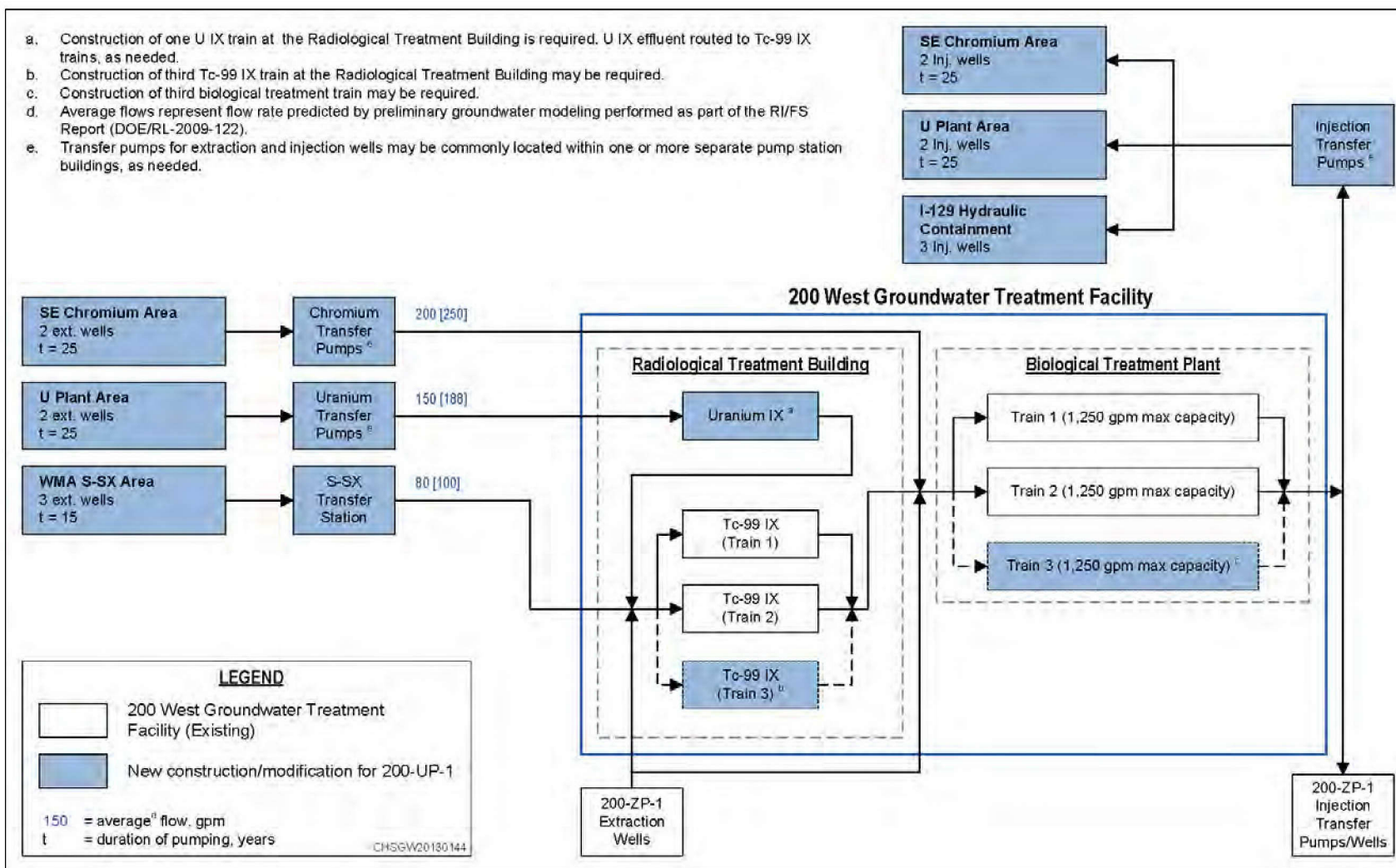


Figure 2-2. Conceptual Block Flow Diagram for the 200-UP-1 Remedy

2.1.2 Monitored Natural Attenuation Component

In addition to the P&T system, the 200-UP-1 OU remedy includes natural attenuation processes to reduce contaminant concentrations to below the cleanup levels. These natural processes include physical, chemical, and biological transformations that occur without human intervention. The RI/FS report (DOE/RL-2009-122) documents information supporting the conclusion that MNA will occur in combination with P&T activities to achieve the remediation goals. Natural attenuation will eventually become the dominant mechanism for continued reduction of contaminant concentrations in the 200-UP-1 OU as P&T is completed.

MNA will be used to address the diffuse (low-concentration) nitrate plume areas not captured by the extraction wells. MNA will also address the portion of the carbon tetrachloride plume that remains after the active pumping period. The remaining carbon tetrachloride will require the longest MNA time frame (estimated to be 125 years), which is consistent with the time frame for carbon tetrachloride remediation in the adjacent 200-ZP-1 OU (EPA et al., 2008). There is no viable treatment technology to remove tritium from groundwater. However, the half-life of tritium (12.3 years) is sufficiently short, so tritium will decay below the cleanup level in a reasonable time frame (estimated to be 25 years).

Monitoring will be employed to evaluate and confirm the effectiveness of the natural attenuation processes. Monitoring well locations, activities, and specifications to evaluate MNA performance will be defined in the PMP as part of the overall remedy performance monitoring program discussed in Section 2.1.4.

2.1.3 Iodine-129 Hydraulic Containment and Treatment Technology Evaluation Component

Hydraulic containment of the iodine-129 plume will be implemented until a subsequent remedial decision for the plume is made. Effective hydraulic containment is expected to rely on injection wells placed at the leading edge of the iodine-129 plume. Treated water from the 200 West Groundwater Treatment Facility will be pumped to the injection wells. It is estimated that three injection wells with a flow rate of 189 L/min (50 gpm) per well (568 L/min [150 gpm] total) will be needed to hydraulically control the plume.

The technology evaluation for iodine-129 completed as part of the feasibility study (DOE/RL-2009-122) determined that there is currently no treatment technology that can achieve the federal DWS of 1 pCi/L for the iodine-129 concentrations present in the 200-UP-1 OU. Therefore, P&T is not currently a viable remedy for this contaminant. The ROD requires that DOE evaluate potential treatment options for iodine-129 as part of the selected remedy through further technology evaluation. The approach to the evaluation will be defined in an iodine-129 technology evaluation plan to be reviewed and approved by EPA. The evaluation will include an update to the conceptual model for the plume, a review of current literature, and a feasibility analysis of potential treatment options. The feasibility analysis will evaluate available options based on cost, effectiveness, and implementability, and will serve as the basis for path-forward recommendations, such as treatability testing. If one or more viable technologies are identified, treatability testing will be conducted in accordance with a treatability test plan subject to review and approval by EPA.

2.1.4 Remedy Performance Monitoring Component

Remedy performance monitoring will be conducted over the lifetime of the interim remedial action to evaluate its performance and optimize its effectiveness. Monitoring will be conducted to evaluate the performance of the P&T system, hydraulic containment, and MNA components of the selected remedy and shall be designed and operated as follows:

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- 1 • To demonstrate whether the remedial action being taken, including natural attenuation, will achieve
2 cleanup levels for all COCs (except for iodine-129) in the estimated time frame
- 3 • To detect changes in environmental conditions (e.g., hydrogeologic, geochemical, microbiological, or
4 other changes) that may impact the P&T system, natural attenuation processes, and the hydraulic
5 containment actions
- 6 • To verify that the contamination is not expanding downgradient, laterally, or vertically subsequent to
7 the period of time over which the P&T and hydraulic containment components have been functional
- 8 • To detect new releases of contaminants of potential concern (COPCs) to the environment that could
9 impact the effectiveness of the remedy
- 10 • To verify attainment of remediation requirements

11 Remedy performance monitoring requirements will be defined in the O&M plan or the PMP. Process
12 control monitoring requirements (including measurement of extraction/injection well flow rates and water
13 levels, radiochemistry of extracted groundwater, and the performance of the 200 West Groundwater
14 Treatment Facility) will be defined in the O&M plan. Remedy performance monitoring of the aquifer
15 (including groundwater sampling and analysis and water-level measurements using monitoring wells)
16 will be defined in the PMP.

17 Process performance monitoring for the extraction/injection well network will include sampling and
18 analysis of extracted groundwater for COCs, and measurement of extraction/injection well flow rates and
19 water levels. This will allow for evaluation of each contaminant's mass removal rate and the effectiveness
20 of the P&T component. Process control monitoring requirements for extraction and injection wells and
21 the 200 West Groundwater Treatment Facility will be determined during remedial design and defined in
22 the O&M plan, subject to EPA review and approval.

23 Aquifer performance monitoring will include water-level measurements and groundwater sampling and
24 analysis of monitoring wells to assess changes in contaminant plume geometry and concentrations, and
25 the effectiveness of hydraulic controls (including the effectiveness of the injection well network to
26 achieve hydraulic containment of the iodine-129 plume). In addition, the data collected will be used to
27 assess whether the key mechanisms of natural attenuation are performing in a manner to satisfy remedy
28 requirements for carbon tetrachloride, tritium, and nitrate (as discussed in Section 2.1.2). Since cleanup
29 decisions for the soil OUs located above the 200-UP-1 OU have not yet been identified, monitoring will
30 be conducted for the final COPCs (which include the COCs, plus 1,4-dioxane, chloroform,
31 tetrachloroethene, trichloroethene, and strontium-90). Monitoring for these constituents will help to
32 determine if additional contaminants from source units are impacting groundwater at concentrations that
33 may pose an unacceptable risk to human health or the environment. Groundwater monitoring well
34 locations and associated sampling and analysis requirements will be described in the PMP, subject to
35 EPA review and approval.

36 The DOE will conduct 5 year reviews of the performance of the selected remedy in accordance with EPA
37 policy until levels that allow for unlimited use and unrestricted exposure are achieved. Reviews will begin
38 no later than 5 years after initiation of the remedial action to help ensure that the selected remedy is
39 protective of human health and the environment.

40 **2.1.5 Institutional Controls Component**

41 ICs are instruments, such as administrative and/or legal restrictions, that are designed to control or
42 eliminate specific pathways of exposure to contaminants until remedial goals are achieved. ICs will be

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1 required for the 200-UP-1 OU as long as groundwater contamination precludes its use as a potential
2 source of drinking water. These ICs include the requirement that DOE control access to groundwater to
3 prevent exposure of humans to contaminated groundwater, except as otherwise authorized by EPA, and
4 the requirement that DOE control activities that would damage components of the remedy or disrupt or
5 lessen performance of any component of the remedy.

6 As defined in the 200-UP-1 OU ROD, the ICs required through the time of completion of the remedy are
7 as follows:

- 8 • The DOE shall control access to 200-UP-1 OU groundwater to prevent unacceptable exposure of
9 humans to contaminants, except as otherwise authorized in lead regulatory agency
10 approved documents.
- 11 • Visitors entering any site areas of the 200-UP-1 OU will be required to be badged and escorted at
12 all times.
- 13 • No intrusive work shall be allowed in the 200-UP-1 OU unless the lead regulatory agency has
14 approved the plan for such work and that plan is followed.
- 15 • The DOE shall prohibit well drilling in the 200-UP-1 OU, except for monitoring, characterization, or
16 remediation wells authorized in EPA-approved documents.
- 17 • Groundwater use in the 200-UP-1 OU is prohibited, except for limited research purposes, monitoring,
18 and treatment authorized in EPA-approved documents.
- 19 • The DOE shall post and maintain warning signs along pipelines conveying untreated groundwater
20 that caution site visitors and workers of potential hazards from the 200-UP-1 OU.
- 21 • In the event of any unauthorized access (e.g., trespassing), DOE shall report such incidents to the
22 Benton County Sheriff's Office for investigation and evaluation of possible prosecution.
- 23 • Activities that would disrupt or lessen the performance of the any component of the remedy are to
24 be prohibited, except as otherwise authorized in lead regulatory agency-approved documents.
- 25 • The DOE shall prohibit activities that would damage the remedy components (e.g., extraction wells,
26 piping, treatment plant, and monitoring wells), except as otherwise authorized in lead regulatory
27 agency-approved documents.
- 28 • The DOE will prevent the development and use of property above the 200-UP-1 OU for residential
29 housing, elementary and secondary schools, childcare facilities, and playgrounds.
- 30 • The DOE shall report on the effectiveness of ICs for the 200-UP-1 OU interim remedy in an annual
31 report, or on an alternative reporting frequency specified by the lead regulatory agency. Such
32 reporting may be for the 200-UP-1 OU alone or may be part of the Hanford Site-wide report.
- 33 • Measures that are necessary to ensure continuation of ICs shall be taken before any lease or transfer
34 of any land above the 200-UP-1 OU. DOE will provide notice to Ecology and EPA at least 6 months
35 before any transfer or sale of 200-UP-1 OU or any land above the 200-UP-1 OU so the lead
36 regulatory agency can be involved in discussions to ensure that appropriate provisions are included in
37 the transfer terms or conveyance documents to maintain effective ICs. If it is not possible for DOE to
38 notify Ecology and EPA at least 6 months before any transfer or sale, DOE will notify Ecology and
39 EPA as soon as possible, but no later than 60 days before the transfer or sale of any property subject
40 to ICs. In addition to the land transfer notice and discussion provisions, DOE further agrees to

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provide Ecology and EPA with similar notice, within the same time frames, as to federal-to-federal transfer of property. DOE shall provide a copy of the executed deed or transfer assembly to Ecology and EPA.

- DOE shall notify EPA and Ecology immediately upon discovery of any activity inconsistent with the OU-specific institutional control objectives for the Site.

The *Sitewide Institutional Controls Plan for Hanford CERCLA Response Actions and RCRA Corrective Actions* (DOE/RL-2001-41) identifies the current ICs for the Hanford Site, and it also describes how ICs are implemented and maintained, serving as a reference point for the selection of ICs in the future. The current plan provides a foundation from which to identify the long-term controls needed to prevent exposure during the restoration time frame. The Sitewide IC plan will be updated within 180 days following the approval of the 200-UP-1 OU ROD (which occurred on September 27, 2012) to include the above ICs required by the ROD and will specify the implementation and maintenance actions that will be taken, including periodic inspections. The revised Sitewide IC plan will be submitted to EPA and Ecology for review and approval as a Tri-Party Agreement primary document.

2.2 Remedial Action Objectives

The RAOs are site-specific objectives that define the extent of cleanup necessary to achieve the specific level of remediation at the site. The RAOs identified in the 200-UP-1 OU ROD are as follows:

- **RAO #1:** Return the 200-UP-1 OU groundwater to beneficial use as a potential drinking water source.
- **RAO #2:** Prevent human exposure to contaminated 200-UP-1 OU groundwater that exceeds acceptable risk levels for drinking water.

The RAOs are based on restoring groundwater as a potential future drinking water source. Groundwater from the 200-UP-1 OU is contaminated and is not currently withdrawn from the aquifer for beneficial use; however, the potential beneficial use of the groundwater is as a drinking water source. Consistent with the beneficial-use classifications of Washington State and EPA, the goal for remediating 200-UP-1 OU groundwater is to reduce contamination to levels that will allow its use as a future drinking water source.

As discussed in the ROD, RAO #1 will be addressed by reducing the COC concentrations in 200-UP-1 OU groundwater to levels corresponding to or below the federal DWSs or WAC 173-340-720 groundwater cleanup levels identified in Table 2-1. RAO #2 calls for the prevention of groundwater use until cleanup levels protective of domestic groundwater use are achieved. This objective will be addressed by preventing exposure to the contaminated groundwater by prohibiting use of groundwater for drinking or other domestic uses until RAO #1 is achieved.

2.3 Cleanup Levels

The cleanup levels for the 200-UP-1 OU COCs are listed in Table 2-1, as defined in the ROD. The cleanup levels for this 200-UP-1 OU groundwater interim remedial action are federal and state drinking water MCLs and state groundwater cleanup levels (where more stringent than the MCLs) that are ARARs for the selected remedy. These cleanup levels define acceptable risk levels for potential beneficial use of the groundwater as drinking water.

Table 2-1. Cleanup Levels for 200-UP-1 OU COCs

COCs	Units	90 th Percentile Groundwater Concentrations	Federal DWS	MTCA Method B Cleanup Levels		Cleanup Level
				Non-carcinogens at HQ = 1	Carcinogens at 1×10^{-6} Risk Level	
Iodine-129	pCi/L	3.5	1	—	—	1 ^d
Technetium-99	pCi/L	4,150	900	—	—	900
Tritium	pCi/L	51,150	20,000	—	—	20,000
Uranium	µg/L	206	30	—	—	30
Nitrate ^b (as NO ₃)	mg/L	133	45	113.6	—	45
Nitrate ^b (as N)	mg/L	30.1	10	25.6	—	10
Total chromium	µg/L	99	100	24,000	—	100
Hexavalent chromium	µg/L	52	—	48	—	48
Carbon tetrachloride	µg/L	189	5	5.6	0.34 ^e	3.4 ^f

Source: Table 14 of the *Record of Decision for Interim Remedial Action, Hanford 200 Area Superfund Site, 200-UP-1 Operable Unit* (EPA et al., 2012).

a. Federal DWS from 40 CFR 141, “National Primary Drinking Water Regulations,” with iodine-129 and technetium-99 values from EPA 816-F-00-002, *Implementation Guide for Radionuclides*.

b. Nitrate (NO₃) may be expressed as the ion NO₃ (NO₃- NO₃) or as nitrogen (NO₃-N). The federal DWS for nitrate is 10 mg/L expressed as N, and 45 mg/L expressed as NO₃-. The Washington State cleanup level is 25.6 mg/L, as nitrogen.

c. There is no federal DWS for hexavalent chromium.

d. Currently identified groundwater treatment technology is insufficient to reach the 1 pCi/L DWS.

e. This value is represents estimated risk from an individual contaminant, at 1×10^{-6} risk level.

f. This cleanup level is a risk-based calculation for carbon tetrachloride. This value represents a cumulative 1×10^{-5} risk in accordance with WAC 173-340-720(7)(a).

COC = contaminant of concern

HQ = hazard quotient

DWS = drinking water standard

MTCA = Model Toxics Control Act

2.3.1 Attainment of Cleanup Levels

A typical conceptual timeline for groundwater remediation progress for a specific well is shown in Figure 2-3 (EPA/230-R-92-014, *Methods for Evaluating the Attainment of Cleanup Standards, Volume 2: Ground Water*) for illustrative purpose. Several mileposts in the remediation process are shown in Figure 2-3, including the following:

- Start of treatment
- Performance monitoring to guide remedy optimization and determine the end of active/passive remediation
- End of remediation

- Start of compliance monitoring to confirm that concentrations remain below the cleanup levels
- Determination of whether cleanup levels have been achieved throughout the aquifer and the completion of compliance monitoring

The groundwater concentrations shown on Figure 2-3 illustrate typical responses to each of these steps. Remediation activities within the 200-UP-1 OU are expected to follow a similar pattern. Two aspects of particular concern in this timeline are (1) determining when to end active remediation, and (2) determining when RAOs can be demonstrated to be attained. The relative length of these time horizons will be different for each COC. For example, tritium is expected to decay to levels below the cleanup level in less than 25 years by MNA alone. As explained in Section 2.1, the selected remedy is expected to achieve cleanup levels for technetium-99 within 15 years, for uranium within 25 years, for chromium (total and hexavalent) within 25 years, and for nitrate within 35 years through P&T and MNA. Finally, carbon tetrachloride is expected to require a total remediation duration of approximately 125 years (including active restoration and MNA). Natural attenuation (passive remediation) will eventually become the dominant mechanism for continued reduction of contaminant concentrations in the 200-UP-1 OU as the P&T component (active remediation) is completed.

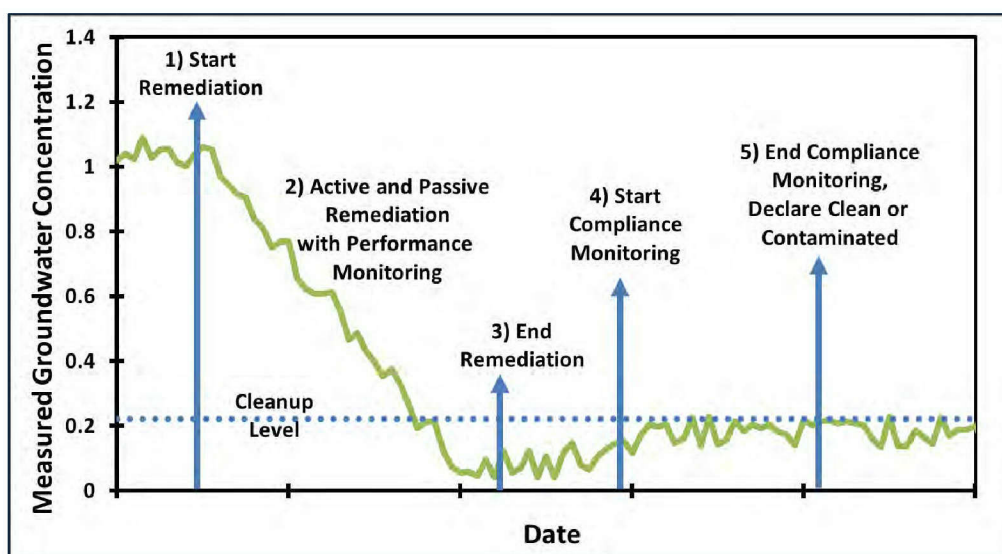


Figure 2-3. Typical Conceptual Timeline for Groundwater Remediation Progress

During the performance monitoring time frame, statistical evaluation of monitoring well data will be performed to assess progress in achieving cleanup levels. The process will follow groundwater risk assessment guidance, where the exposure point concentration for each plume within the OU will be continuously evaluated based on available performance monitoring measurements. The statistical analysis will consist of calculating the upper one-sided 95 percent confidence limit (UCL_{95}) for each COC for comparison to the cleanup levels. The UCL_{95} will be calculated periodically as new monitoring data are collected to assess progress in achieving cleanup levels and the need for continued active remediation. Following the active remediation period, MNA will be evaluated continuously (using the same statistical approach) to ensure that cleanup levels have been achieved throughout the contaminated groundwater plumes. The statistical evaluation will follow the guidance provided in EPA 230-R-92-014, and the *Model Toxics Control Act* (MTCA) (WAC 173-340-720[8-9]). MTCA (WAC 173-340-720[8-9]) provides guidance for comparison of the water quality data collected at monitoring wells to the cleanup levels. EPA 230-92-014 provides details on the type of statistical analysis described in the MTCA documentation.

The details of the performance monitoring program (e.g., well locations and sampling frequency) for collecting data necessary to support the UCL_{95} calculation will be defined in the PMP and associated sampling and analysis plan (SAP) (discussed in Section 2.4). A unique monitoring well set is expected to be defined for each COC plume or remediation area because the plumes have unique spatial distributions. The statistical methods used to analyze the monitoring well data will be detailed in the PMP, following the above mentioned regulatory guidance documents.

Compliance monitoring includes observational data that are used to determine whether a remedial action has achieved the goal(s). This type of monitoring cannot begin at a point of compliance until the active remediation and MNA have been declared to achieve their objectives. When the remedial action is P&T, all extraction wells influencing the point of compliance must cease extraction and injection prior to compliance monitoring. This differs from performance monitoring, which occurs throughout the lifecycle of the remedial action. Performance monitoring and compliance monitoring are likely, but not required, to occur at the same locations. CERCLA guidance requires compliance monitoring to be conducted for at least 3 years from the end of active remedial activities (including MNA). It is typically expected that some rebound of contaminant concentration will occur after termination of remedial activities. The 3-year time frame is specified to capture this effect and quantify whether remedial actions were successful. Compliance monitoring data analyses will consist of calculating the upper one-sided 95 percent confidence limit (UCL_{95}) for each COC on a well-by-well basis using a representative data set for comparison to cleanup levels.

2.4 Remedy Performance Monitoring

Performance monitoring will be conducted to evaluate the effectiveness of the remedial action in attaining cleanup levels. This monitoring will address the different elements associated with the remedial action, including the extraction and injection well network, treatment system, and monitoring well network.

Process monitoring (e.g., well flow rates, water levels, and COC concentrations) involving extraction/injection well and 200 West Groundwater Treatment Facility performance will be defined in the O&M plan. This will be integrated with the 200-ZP-1 OU, as remedial actions for both OUs will share a common treatment facility. The 200 West Groundwater Treatment Facility was constructed under the 200-ZP-1 OU remedial action and was sized to accommodate the 200-UP-1 OU remedial action. The 200-ZP-1 OU and WMA S-SX extraction/injection wells, pipelines, transfer buildings, and treatment facility are currently managed under the *200 West Area Pump-and-Treat Facility Operations and Maintenance Plan* (DOE/RL-2009-124). The O&M plan outlines the activities necessary to operate, maintain, and monitor performance of the 200 West Groundwater Treatment Facility and associated pumping system from completion of construction through decommissioning. The latest version of this O&M plan will be revised/updated to incorporate the 200-UP-1 P&T system.

Remedy performance monitoring of the 200-UP-1 OU aquifer and associated monitoring well network will be defined in the PMP. The PMP will be a stand-alone document focused on aquifer monitoring activities to assess progress in achieving RAOs and will include the collection of data to evaluate changes in contaminant plume geometry, hydraulic controls (including plume capture or containment), and the effectiveness of natural attenuation processes. The PMP will include a SAP addressing monitoring well locations, sampling methods, the types and frequency of data to be collected, analyses and calculations (e.g., UCL_{95}) to be performed, and recommendations for new wells. The flexibility of completing new monitoring wells for dual use (monitoring or extraction/injection) will be considered during well design. The PMP will be updated as needed to address changing hydraulic and contaminant distribution conditions. Monitoring will be integrated with the 200-ZP-1 PMP (DOE/RL-2009-115) to support a cost-effective monitoring program. The PMP will not address monitoring of the treatment process, which will be addressed in the 200 West P&T O&M plan.

2.4.1 Extraction/Injection Well Network Performance Monitoring

Performance monitoring of the extraction well network will be designed to evaluate contaminant mass removal from the 200-UP-1 OU aquifer. The design will include hydraulic, radiological, and chemical monitoring of the extraction wells. Hydraulic monitoring will consist of measuring flow rates, total flow, and water levels for each extraction well. Hydraulic monitoring will also be performed for each injection well.

The flow measurements will be used in conjunction with radiological and chemical monitoring data to calculate the rate of contaminant mass removal and the total contaminant mass removed. Water-level measurements will be used to evaluate whether the extraction and injection wells are operating within their design criteria. Well discharge rates may be adjusted based on this data to optimize the drawdown in each extraction well or the hydraulic head in the injection wells.

Radiological and chemical monitoring will consist of extraction well discharge sampling for the COCs. The extraction well analytical data will be used in conjunction with the flow monitoring data to calculate the rate of contaminant mass removal and to track the total contaminant mass removed by each extraction well. During startup, the sampling frequency will be higher (e.g., on a monthly basis). Once contaminant concentration trends have been identified, the sampling frequency will be reduced.

A SAP will be prepared to define samples to be collected during the drilling of extraction and injection wells defined in the remedial design. The SAP will address sampling methods, the types and frequency of data to be collected, and the analyses to be performed, and will be prepared as part of the RDR effort. The information will be used to define well completion requirements as discussed in Section 3.2.1.

2.4.2 Treatment System Performance Monitoring

Performance monitoring of the treatment system will be designed to evaluate COC removal efficiency and to ensure that the treated groundwater meets the injection requirements before being returned to the aquifer. The design will include hydraulic, radiological and chemical monitoring of the treatment process. Hydraulic monitoring will consist of measuring flow rates and total flow at the treatment system influent. This information, along with the contaminant concentrations of the influent and effluent water, will be used to determine the contaminant mass reduction from the treatment system.

Radiological and chemical monitoring will consist of treatment system influent and effluent sampling for COCs. The goals are to determine whether the treatment system is reducing contaminant concentrations below cleanup levels and to ensure compliance with these standards. During startup, sampling will be performed more frequently (e.g., on a monthly basis). With operational experience and after contaminant concentration trends have been identified, the sampling frequency will be reduced. Real-time monitoring may be performed if current technology can cost effectively achieve the necessary detection limits. The sampling and analysis requirements defined in the 200 West P&T O&M plan (DOE/RL-2009-124) will be updated to incorporate the 200-UP-1 P&T system.

2.4.3 Monitoring Well Network Performance Monitoring

Groundwater plume and water table monitoring (i.e., monitoring well sampling and analysis, and water-level measurements) will be performed to assess the response of the contaminant plumes to the remedy over time and to ensure effective plume capture or hydraulic control. During the active pump-and-treat period, the data will be used to calculate the UCL₉₅ for individual COCs and changes in plume size or concentrations over time as a measure of cleanup progress over each plume area. In addition, the data will be used to optimize, as needed, the performance of the P&T component and the injection well network to hydraulically contain the iodine-129 plume.

Performance monitoring of the well network will ensure that the appropriate data are being collected to evaluate remedy performance. As many as 100 monitoring wells in the 200-UP-1 OU will be evaluated

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for use during performance monitoring. The evaluation will identify appropriate well locations for monitoring and sampling frequencies and will help integrate with other monitoring programs to identify redundancies or deficiencies in the monitoring network. This effort is expected to result in recommendations for the installation of additional monitoring wells in areas of the 200-UP-1 OU where monitoring control is lacking or deficient, as well as the identification of existing wells that may not be required for remedy monitoring.

The performance monitoring well network is expected to include areas near and downgradient of the source or active waste management units, areas of highest plume concentration, and areas downgradient of plume fringes or plume boundaries or other compliance boundaries. Once an appropriate monitoring well network has been established under an approved PMP, performance monitoring activities will be implemented. Prior to the completion of the PMP, groundwater monitoring of the 200-UP-1 OU will continue as scheduled in Appendix B. This sampling schedule provides for a continuing groundwater monitoring program over this interim period to track changes in the groundwater plumes and to provide current data for remedial design. Once issued, the PMP will supersede any existing CERCLA groundwater monitoring plan or program for this OU.

Hydraulic monitoring will consist of measuring water levels at select monitoring wells. The water-level data will be used to generate a water table map for the unconfined aquifer. This information will be used to evaluate groundwater plume capture by the extraction well field and flow-path control by the injection well field using groundwater flow modeling, particle-tracking analysis, or other appropriate analytical tools.

Radiological and chemical monitoring will consist of sampling the monitoring wells for COCs, as well as the final COPCs (which include the COCs, plus 1,4-dioxane, chloroform, tetrachloroethene, trichloroethene, and strontium-90). In addition to these constituents, other parameters may be identified to better understand natural attenuation mechanisms in the OU.

A baseline will be established for the monitoring well network prior to the startup of the P&T component of the selected remedy. The monitoring frequency is anticipated to be more frequent at the start of remedy performance monitoring. Once contaminant concentration and water-level trends have been identified, the sampling frequency will be reduced.

2.4.4 Integrated Groundwater Monitoring

The groundwater monitoring program developed in the PMP will consider all existing monitoring programs within the 200-UP-1 OU and nearby 200-ZP-1 OU, including the following:

- Groundwater monitoring at RCRA TSD units, which include the WMA S-SX Tank Farms, the WMA U Tank Farm, and the 216-S-10 Pond and Ditch
- Sitewide surveillance monitoring under the AEA
- PMP for the 200-ZP-1 OU (DOE/RL-2009-115)
- CERCLA groundwater monitoring at the ERDF (WCH-198)

The goal of integrating these programs is to minimize duplication of effort and inconsistencies while satisfying regulatory requirements. Impact to existing programs from the implementation of 200-UP-1 OU remedial action will be identified so proper adjustments to the existing programs can be made as needed.

2.5 Applicable or Relevant and Appropriate Requirement Compliance

The ARAR implementation strategy for the 200-UP-1 OU remedial action is provided in Appendix C.

3 Remedial Design Approach

This section addresses the approach to the remedial design process for the 200-UP-1 OU remedy, including the information and activities necessary to support completion of the remedial design. Design basis considerations are addressed in Section 3.1. The remaining sections of this chapter include discussion of the following:

- Network of extraction and injection wells for the 200-UP-1 OU (Section 3.2)
- 200 West Groundwater Treatment Facility (Section 3.3)
- Balance of plant, which includes the wellhead racks, piping, transfer buildings with transfer pumps, and associated utilities to pump the extraction groundwater to the 200 West Groundwater Treatment Facility and return treated water to the injection wells (Section 3.4)
- Summary of the phased approach to design, including discussion on the RDR, the O&M plan, the PMP, and the iodine-129 technology evaluation plan (Section 3.5)

3.1 Design Basis

The section discusses the general approach to implementing the 200-UP-1 OU remedy. Design basis considerations are also presented, including COC information, preliminary groundwater fate and transport modeling results, and high-level functional requirements for the P&T system.

3.1.1 Implementation Approach

Implementation of the 200-UP-1 OU remedy will be performed in a sequenced manner. As discussed in Section 2.1, the selected remedy combines groundwater P&T for parts of the carbon tetrachloride plume, technetium-99 plumes, uranium plume, high-concentration nitrate plume, and the chromium (total and hexavalent) plumes; with hydraulic containment of the iodine-129 plume, MNA, and remedy performance monitoring. A conceptual layout of the P&T and hydraulic control system is illustrated in Figure 2-1.

The P&T component will be implemented by plume area as follows:

- **WMA S-SX plume area:** The primary COC in this area is technetium-99 with emerging chromium and nitrate plumes originating from past unplanned releases and leaks from WMA S-SX SSTs. The extraction system for this area began operating in 2012 in accordance with the *200-UP-1 Groundwater Remedial Design/Remedial Action Work Plan* (DOE/RL-97-36, Rev. 3) and will continue to operate under this RD/RA work plan. The focus of this extraction system is the capture and removal of two technetium-99 plumes (Figure 1-4) located downgradient of WMA S-SX. Capturing the technetium-99 plume effectively captures the emerging chromium and nitrate plumes, as well as a portion of the carbon tetrachloride plume that originates from the 200-ZP-1 OU. The extraction system (three wells) is designed to operate at a total average extraction rate of 303 L/min (80 gpm) and is expected to operate for a period of approximately 15 years based on current plume conditions. The duration of operations may be extended if WMA S-SX vadose zone contamination continues to contribute to groundwater contamination exceeding cleanup levels.
- **U Plant plume area:** The primary COC in this area is uranium with technetium-99 and nitrate that originated primarily from past releases to the 216-U-1/U-2 Cribs located on upgradient edge of the uranium plume (Figure 1-3). Beginning in 1985, this area has undergone focused groundwater remediation efforts to remove higher concentrations of uranium (greater than 300 µg/L) and technetium-99 (greater than 9,000 pCi/L), as discussed in Section 2.2 of the 200-UP-1 OU ROD

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(EPA et al., 2012) and DOE/RL-97-36. The focus of the new extraction/injection system under this plan is the cleanup of the remaining portions of the uranium and technetium-99 plumes. Associated higher levels of nitrate will also be extracted locally, as well as carbon tetrachloride that has migrated into the area from the 200-ZP-1 OU. The system is expected to require approximately two extraction and two injection wells, operating at an approximate total average flow rate of 568 L/min (150 gpm) for 25 years based on current contamination conditions.

- **Southeast chromium plume area:** This area is located in the far southeastern portion of the 200-UP-1 OU that is primarily associated with historic waste discharges to the 216-S-20 Crib. The chromium plume is largely isolated in this area and has not been well characterized. As an initial step in implementing the remedy in this area, additional monitoring wells will need to be installed to further characterize the vertical and lateral extent of the plume in support of remedial design. The system is expected to require approximately two extraction and two injection wells, operating at an approximate total average flow rate of 757 L/min (200 gpm) for 25 years based on current contamination conditions.

The hydraulic containment component to control the migration of the iodine-129 plume is expected to consist of a set of injection wells (approximately three) placed at the leading edge of the plume, with an approximate total average flow rate of 568 L/min (150 gpm). Hydraulic containment of the iodine-129 plume will continue until a subsequent remedial decision for the plume is made. In addition to implementing the hydraulic containment component, a study will be performed to further evaluate potential treatment options for iodine-129 (to be defined in the iodine-129 technology evaluation plan).

The P&T and hydraulic control system are expected to be implemented by plume area in the following sequence:

- WMA S-SX area P&T system
- U Plant area P&T system
- Iodine-129 plume hydraulic containment system
- Southeast chromium plume area P&T system

Following the approval of this RD/RA work plan, the remedial design process will be implemented in a phased approach (e.g., 30 percent design, 60 percent design, and 90percent designs), as discussed in Section 3.5. The RDR will summarize the 90 percent design, as discussed in Section 3.5.1. In parallel with the RDR effort, the PMP will be prepared to define the remedy performance monitoring approach for the aquifer for all COCs and COPCs, including the MNA approach.

3.1.2 Contaminant Distribution and Design Basis Concentrations

This subsection summarizes 200-UP-1 OU groundwater plume characteristics, as well as the results of preliminary fate and transport modeling that was performed during the RI/FS process to identify initial well locations and extraction rates designed to achieve RAOs with 25 years of P&T. Groundwater concentration information for 200-UP-1 OU COCs and other parameters is also presented.

This information will be updated during preparation of the RDR using current groundwater conditions (e.g., groundwater concentrations, plume geometry, and water table elevation) and updated numerical modeling and plume statistics.

3.1.2.1 Contaminant Distribution

The distribution of 200-UP-1 OU groundwater plumes (location and size) is illustrated on Figure 1-3. Additional discussion of the plume geometry for each COC is provided in Appendix A, with cross sections illustrating the vertical distribution of the plumes. Table 3-1 presents the estimated COC plume area, thickness, volume, 90th percentile concentration, and mass or radionuclide quantity.

**Table 3-1. Characteristics of 200-UP-1 OU COC Plumes,
Including Estimated Plume Area, Pore Volume, and Mass or Radionuclide Quantity**

COC	Porosity ^a	Plume Area, ha (ac) ^b	Estimated Average Plume Thickness, m (ft) ^b	Plume Pore Volume, Billion L(gal)	90 th Percentile Concentration ^b	Estimated COC Mass (Ci)
Uranium	0.2	41 (102)	15 (50)	1.2 (0.3)	206 µg/L	259 kg (571 lb)
Nitrate, as NO ₃	0.2	799 (1,974)	24 (80)	38 (10.3)	133 mg/L	5,174,000 kg (11,407 lb)
Hexavalent chromium	0.2	365 (902)	24 (80)	18 (4.7)	52 µg/L	924 kg (2,038 lb)
Tritium	0.2	680 (1,680)	30 (100)	41 (10.9)	51,150 pCi/L	2,100 Ci
Technetium-99	0.2	19 (46)	20 (65)	0.8 (0.2)	4,150 pCi/L	3 Ci
Iodine-129	0.2	383 (948)	30 (100)	23 (6.2)	3.5 pCi/L	0.1 Ci
Carbon tetrachloride ^c	0.2	585 (1,446)	55 (180)	64 (17.0)	189 µg/L	12,118 kg (26,716 lb)

a. Source: *Record of Decision for Interim Remedial Action, Hanford 200 Area Superfund Site, 200-UP-1 Operable Unit* (EPA et al., 2012) Information was generated in 2009 as part of the RI/FS Report (DOE/RL-2009-122, *Remedial Investigation/Feasibility Study for the 200-UP-1 Groundwater Operable Unit*).

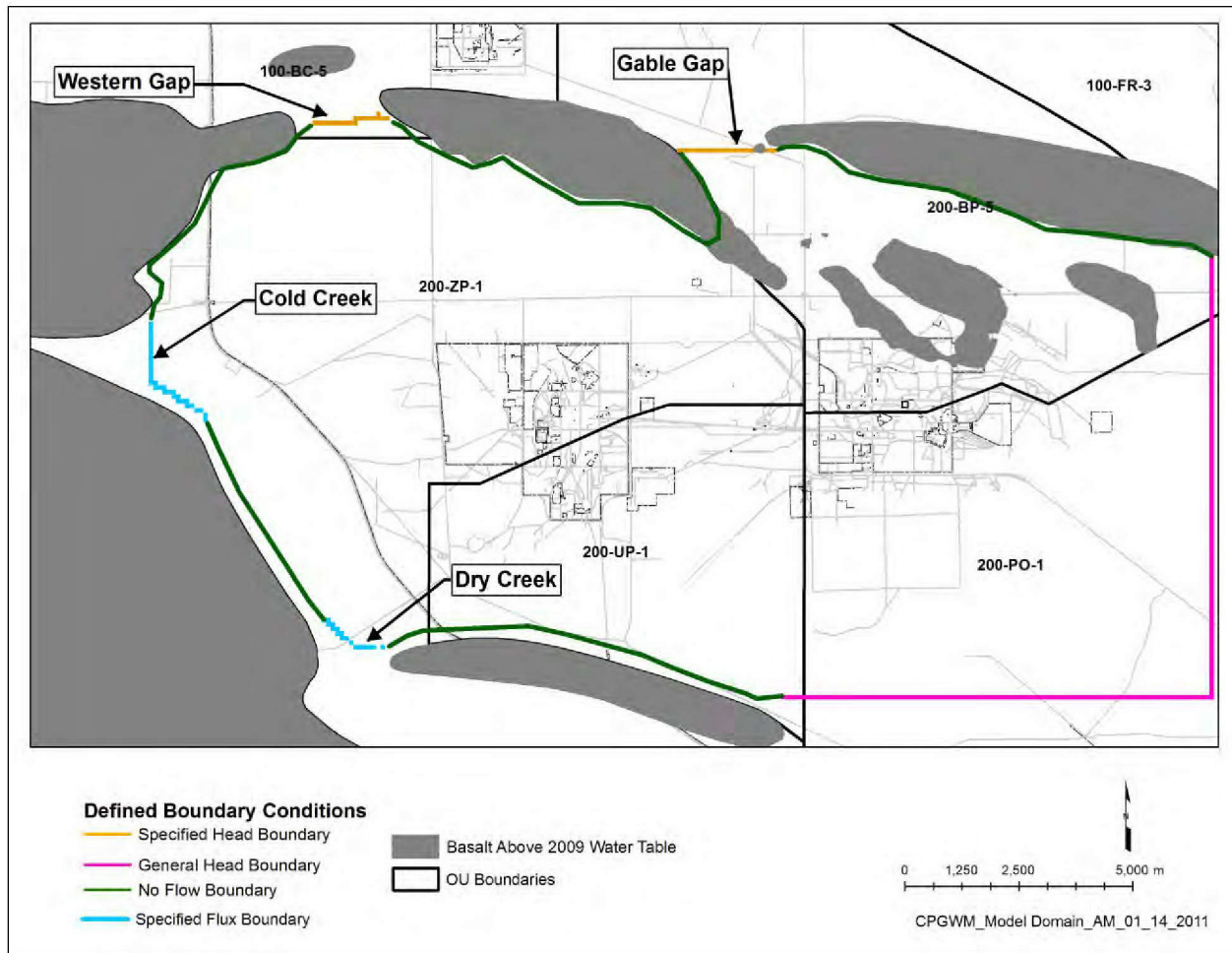
b. Based on *Hanford Site Groundwater Monitoring for 2011* (DOE/RL-2011-118).

c. Includes that portion of the carbon tetrachloride plume with the 200-UP-1 Operable Unit.

COC = contaminant of concern

3.1.2.2 Groundwater Modeling Approach

Groundwater modeling will be performed to provide a basis for the design of the extraction and injection well locations, operating flow rates, and anticipated operating durations. Similar to the approach used in the evaluation of remedial alternatives in the RI/FS (DOE/RL-2009-122), three-dimension numerical modeling will be used to support the remedial design process relying on a set of numerical codes (CH2M HILL Plateau Remediation Company versions of MODFLOW 2000 and MT3DMS). The modeling will simulate groundwater movement and contaminant fate and transport in three dimensions within the Hanford Site Central Plateau unconfined aquifer system, and also associated impacts from hydraulic stresses imposed by extraction and injection wells. The model domain incorporates the entire Central Plateau area, which includes the 200 East and 200 West Areas and a large contiguous surrounding area (Figure 3-1). The objectives of the flow and transport simulations are (1) to identify an optimum set of wells, well screen intervals, and flow rates for a cost-effective pumping system; (2) to assess anticipated remedy durations including the P&T period and transition to MNA, as needed; and (3) to demonstrate that RAOs will be met in the expected time frame.



Source: Model Package Report: Central Plateau Groundwater Model Version 3.3 (CP-47631).

Figure 3-1. Model Domain of the Central Plateau Groundwater Model (Version 3.3)

Collection of hydraulic head, geologic, and contaminant data has continued since the completion of numerical modeling for the RI/FS. The information will be used to update and refine the conceptual site model and numerical model inputs and will include the following:

- The physical geologic model will be updated with data obtained from new borehole logs including updated interpretations of the contacts between the hydrostratigraphic units throughout the 200-UP-1 OU.
- Hydraulic head data will be compared to the existing model predictions, and updates to model inputs (e.g., hydraulic parameters) will be made to enhance model calibration based on the new data.
- Contaminant plume geometries for each of the COCs will be updated based on the most current interpretations published in Hanford Site annual groundwater monitoring reports and integrated into three-dimensional plume geometries using depth discrete groundwater sampling data.

An assumption was made for the RI/FS evaluations that all extraction and injection wells fully penetrate the unconfined aquifers. For the RD/RA work plan, this assumption will be reviewed to evaluate the optimal location of the screened interval to maximize the efficiency for the extraction wells (maximize removal of mass and radioactivity) and injection wells (provide the greatest opportunity for

hydraulic gradient control to prevent contaminated groundwater from moving into clean parts of the aquifers).

The numerical model calibration will be checked after additional lithology and plume geometry information is incorporated into the model. Hydraulic conductivity values for the different hydrostratigraphic units might be adjusted to provide improved accuracy of model predictions for groundwater gradients at key locations that have the greatest impacts on plume capture and mass removal predictions. Key fate and transport parameters are provided in Table 3-2.

Table 3-2. Physical and Transport Characteristics of COCs

COC	Chemical Group	Molecular Weight (g/mole)	Radioactive Half-Life (yr)	Distribution Coefficient (mL/g)
Carbon tetrachloride	Volatile	153.82	N/A	0.011
Chromium	Metal	51.99	N/A	0
Hexavalent chromium	Metal	51.99	N/A	0
Uranium, soluble salts	Metal	238.03	N/A	0.4
Nitrate	Nutrient	62.00	N/A	0
Iodine-129	Radionuclide	129.91	16,000,000	0.1
Technetium-99	Radionuclide	98.91	210,000	0
Tritium	Radionuclide	6.03	12.3	0

Source: Remedial Investigation/Feasibility Study for the 200-UP-1 Groundwater Operable Unit (DOE/RL-2009-122).

N/A = not applicable

Although the Central Plateau model is sufficient to support Central Plateau or OU-scale fate and transport simulations, additional model resolution will be required for plume-scale simulations to support the design of the P&T system. Numerical models with finer grid spacing will be used to provide the required resolution. Refined models are capable of providing more precise estimates of contaminant recovery and/or capture than the original Central Plateau model.

The methodology that will be used for developing the model refinements is referred to as the telescopic mesh refinement (TMR) methodology described in *Procedures and Computer Programs for Telescopic Mesh Refinement Using MODFLOW* (Leake and Claar, 1999). The basic concept consists of using a numerical model with a relatively large domain, and using simulated outputs from that model to develop the model inputs for a model with a relatively smaller domain where more detailed model discretization is desired. The boundary conditions, hydraulic properties, and initial conditions for the subdomain model are extracted from model inputs and simulated results of the larger model. This method is advantageous because it provides consistency between the larger domain and the subdomain, and it allows the model to be used more efficiently for investigating local-scale issues (Leake and Claar, 1999).

With the TMR methodology, a portion of the model domain (where detailed evaluation is needed) is extracted from a larger model domain (i.e., the Central Plateau model). The smaller model is consistent with the inputs and boundary conditions of the larger model; however, the number of grid cells is substantially increased to provide the needed resolution for hydraulic capture zone evaluation. Similar

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refinement of the larger model would make simulations less efficient with respect to the required computing resources. Submodel dimensions and grid coarseness for TMR models developed to assist with detailed design will be determined on a case-by-case basis depending on the footprint of the plume, proposed well locations, and pumping rates for the wells being considered.

The main objectives of the TMR models will be to locate wells and demonstrate hydraulic capture of contaminant plumes. Once the submodel is created, well locations, numbers, and pumping rates will be evaluated to optimize horizontal and vertical placement of the well(s). Hydraulic capture will be demonstrated using the particle-tracking software MODPATH (*User's Guide for MODPATH/MODPATH-PLOT, Version 3: A Particle Tracking Post-Processing Package for MODFLOW, the U.S. Geological Survey Finite-Difference Ground-Water Flow Model* [USGS, 1994]). This software provides the flow-line analysis necessary to qualitatively and quantitatively evaluate the extent of capture provided by the well network design.

This approach was successfully used to design the WMA S-SX extraction system (SGW-40043, *200 West Area Pump and Treat System Functional Design Criteria*). Figure 3-2 provides an example of the MODPATH output that was used for the local WMA S-SX submodel (ECF-200UP1-10-0056, *S-SX Submodel Preliminary Base Case and Sensitivity Analysis Calculations*). Figure 3-2 shows the particle traces overlying the plume boundary, demonstrating qualitatively that hydraulic capture is achieved. Quantitative estimates of the travel time for groundwater are indicated by the timing markers on the particle traces. The list of monitoring wells located within the hydraulic capture zone is also noted. These analyses will be performed for each of the plume areas, and the results will be documented in an environmental calculation. The results of the modeling effort will be summarized in the RDR along with the proposed extraction and injection well locations.

3.1.2.3 Contaminant Reduction Estimates

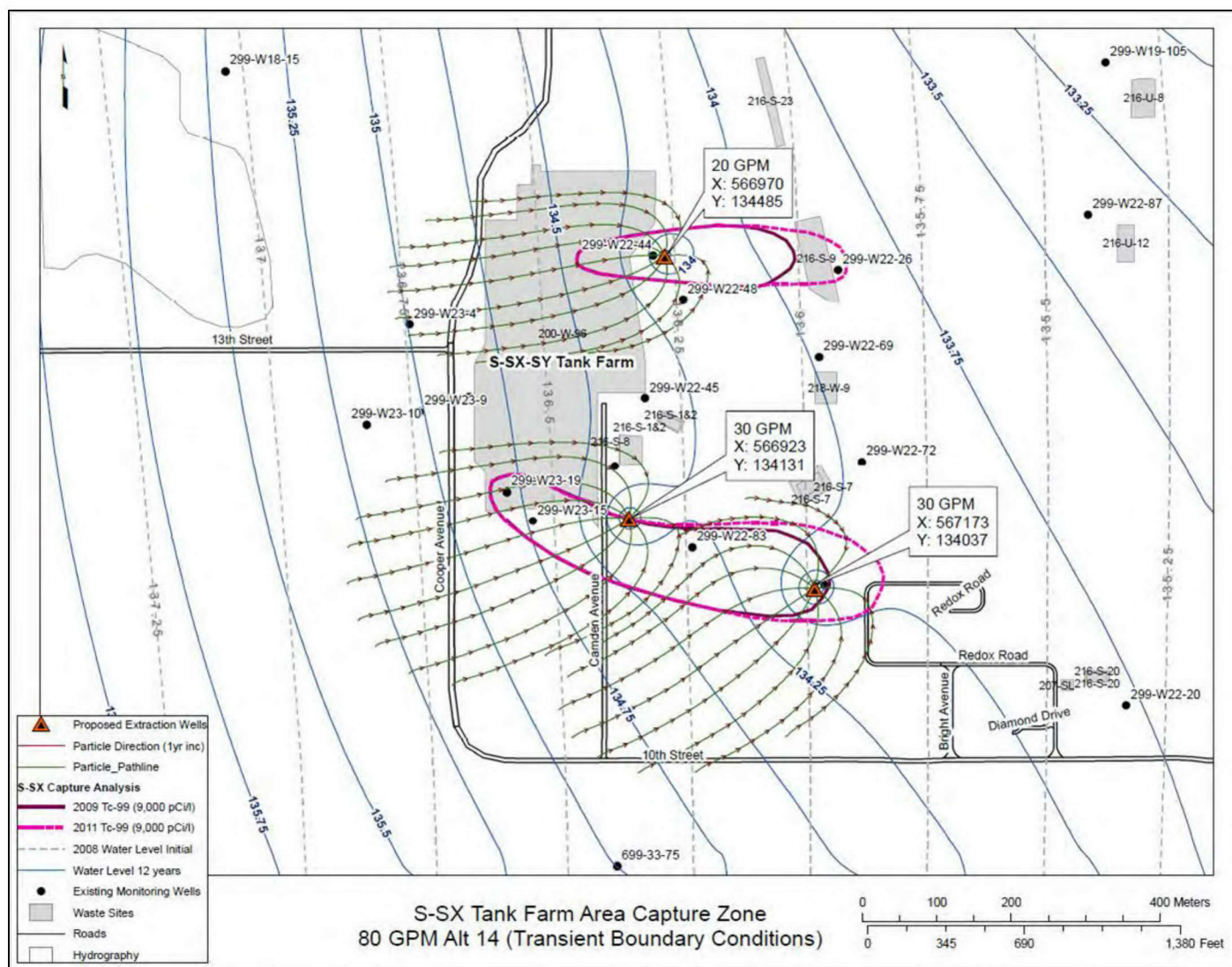
Figure 3-3 depicts the simulated reduction in COC concentrations (UCL_{95}) to their respective cleanup levels over time for each COC actively pumped and assuming the following:

- 15 years of P&T at the WMA S-SX plume area
- 25 years of P&T at the U Plant plume area
- 25 years of P&T at the southeast chromium plume area

The projected natural attenuation of the tritium plume is also shown on Figure 3-3.

3.1.2.4 Design Basis Concentrations

Statistical analyses of groundwater data and numerical groundwater modeling were performed during the RI/FS to represent current and future COC concentrations. Table 3-1 provides information on groundwater concentrations for each of the COCs (expressed as the 90th percentile). Figure 3-2 provides information of the temporal changes in concentrations for COCs actively pumped (expressed as the UCL_{95}). Table 3-3 provides current (calendar year 2011) groundwater concentration data for COCs, as well as other chemical parameters that may be important for treatment process chemistry.



Source: S-SX Submodel Preliminary Base Case and Sensitivity Analysis Calculations (ECF-200UP1-10-0056).

Figure 3-2. MODPATH Particle Tracks with One-Year Intervals Illustrating the Capture Zone Analysis Used in the Design of the WMA S-SX Extraction System

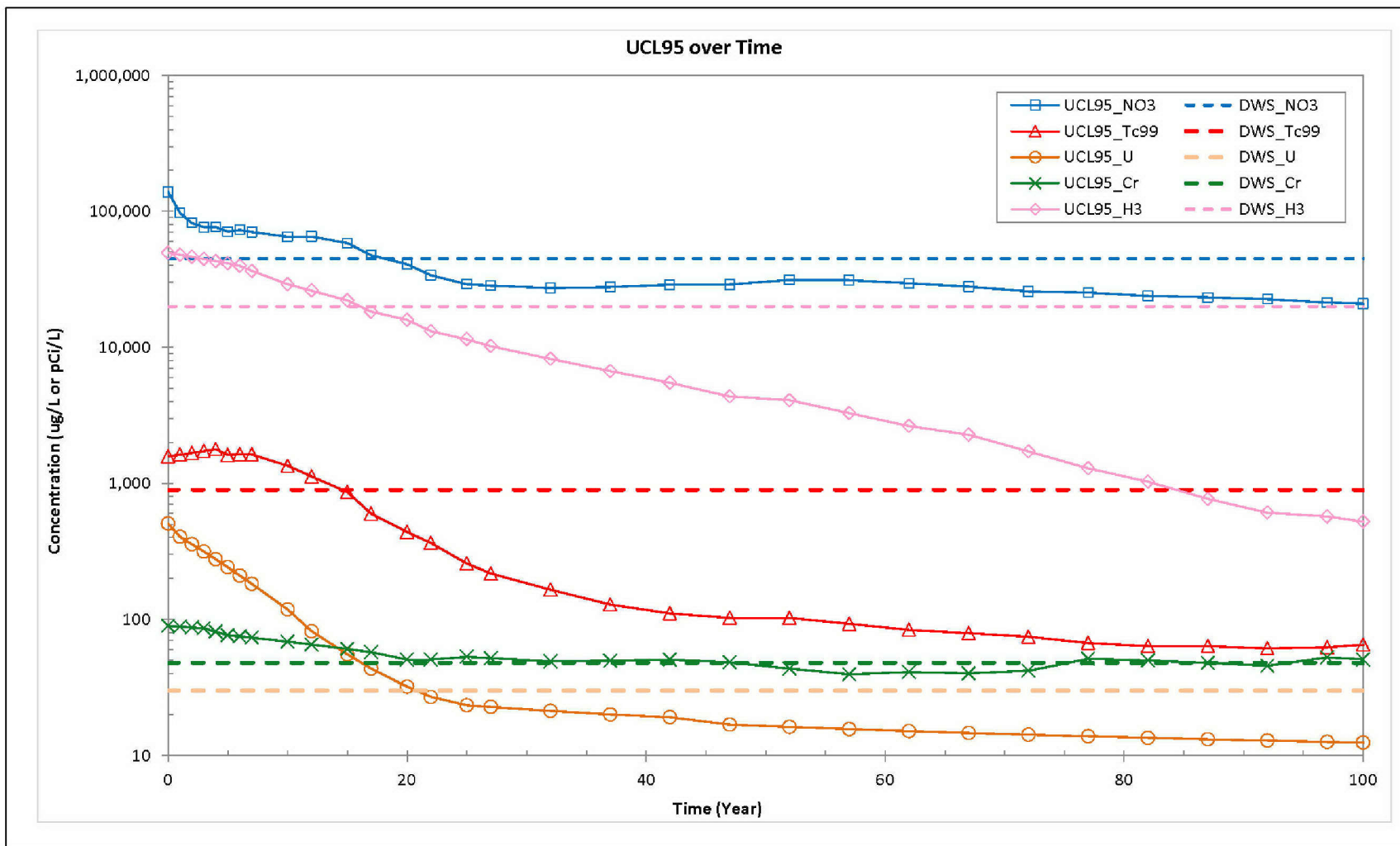


Figure 3-3. Estimated Reduction in COC Exposure Point Concentrations (UCL₉₅) Over Time

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for the 200-UP-1 OU**

Parameter	Concentration
Carbon tetrachloride ^a	980 µg/L
Nitrate as nitrogen ^a	409 mg/L
Hexavalent chromium ^a	865 µg/L
Trichloroethene ^a	8.8 µg/L
Iodine-129 ^a	11.2 pCi/L
Technetium-99 ^a	51,000 pCi/L
Tritium ^a	130,000 pCi/L
Uranium ^a	374 µg/L
Chromium (total) ^b	84.1 µg/L
Alkalinity (as CaCO ₃) ^b	98,800 µg/L
Calcium ^b	39,900 µg/L
Chloride ^b	14,960 µg/L
Chloroform ^b	3.01 µg/L
Fluoride ^b	306 µg/L
Iron (dissolved) ^b	190 µg/L
Magnesium ^b	13,230 µg/L
Manganese (dissolved) ^b	11.3 µg/L
Potassium ^b	4,390 µg/L
Sodium ^b	23,330 µg/L
Sulfate ^b	27,850 µg/L
Total organic carbon ^b	305 µg/L
Total dissolved solids ^b	321,230 µg/L
pH ^b	7.85

Note: The data presented in this table are based on the 2011 annual groundwater dataset.

a. Maximum value.

b. Average value.

- 1 At the initiation of design, current groundwater data will be used to perform updated statistical analyses
- 2 and groundwater modeling. Groundwater statistics will include current UCL₉₅ and maximum
- 3 concentrations and will establish a baseline to assess performance. Groundwater modeling will be used
- 4 to estimate influent concentrations by well, as well as blended concentrations. As the maximum
- 5 concentrations are expected to be encountered during the first year of operation, the highest

concentrations observed during that year will likely be used as the design basis concentration for the treatment system.

3.1.3 Functional Requirements

This section provides the high-level functional requirements for the 200-UP-1 P&T system that will help to guide the design effort. It is intended to document the project team's approach to accomplish the remedial action and is not intended to provide the detailed technical criteria and design requirements based on codes, standards, or DOE orders. These requirements are documented in internal design documents and provide the basis for the subsequent design effort.

The P&T system consists of the following three major subsystems:

- The treatment facility, which is an existing facility that will be modified to accommodate 200-UP-1 OU flows and will house all the process treatment equipment, as well as control systems for P&T operation
- The balance of plant, which includes the piping, transfer buildings, booster pumps, wellhead racks, road crossings, and other equipment as necessary to pump the extracted groundwater to the treatment facility, as well as pump treated groundwater from the treatment facility to the injection well
- Injection and extraction wells

The functional requirements are as follows:

- The system will be designed to extract and treat up to 2,461 L/min (650 gpm), approximately 1.5 times the nominal total flow rate of 1,628 L/min [430 gpm] of extracted groundwater from the 200-UP-1 OU. An additional flow of up to 852 L/min (225 gpm) (1.5 times nominal flow rate of 568 L/min [150 gpm]) will be required from the 200 West P&T to support the iodine-129 hydraulic containment component.
- The 200 West Groundwater Treatment Facility shall be modified as needed to accommodate additional flow and contaminant loading from 200-UP-1 OU groundwater. The treatment facility shall be modified to provide for the treatment of uranium using IX. The need to install additional technetium-99 IX and/or biological process treatment trains will be determined during remedial design.
- The system shall be designed for continuous operation (24 hours/day, 7 days/week) with a control system that integrates with the existing 200 West Groundwater Treatment Facility in providing automated notification during unexpected shutdowns.
- The nominal design life is 25 years. Replacement of process equipment and wells is anticipated to occur during this period as part of ongoing maintenance.
- System redundancy will be similar to that of the 200 West Groundwater Treatment Facility and existing transfer buildings (e.g., redundant transfer pumps).
- Solid waste created by the operation of the treatment system (including resin, sludge, and vapor-phase granular activated carbon [VPGAC]) will increase due to the additional flow. The resin and sludge will be disposed at the ERDF following sludge stabilization, whereas the VPGAC will be sent offsite for regeneration.
- Sampling and monitoring requirements of the extraction and injection wells shall be defined in SAP(s), including depth-discrete groundwater sampling and hydrogeologic testing.

- Warning signs will be posted where pipelines carrying contaminated water intersect or are along roads. These signs will caution site visitors and workers that the pipelines contain contaminated groundwater.

The above functional requirements, as well as remedy-wide functional requirements including existing facility modifications and additions, will be defined in a functional requirements document.

3.2 Well Network Conceptual Design

The preliminary selection of the proposed extraction and injection well locations (Figure 2-1) was based on groundwater flow and transport modeling, and analytical capture zone evaluations performed for the RI/FS report (DOE/RL-2009-122). The number and locations of these wells will be refined as part of the remedial design effort, which will include updated numerical modeling using current groundwater conditions (e.g., groundwater concentrations, plume dimensions, and water table elevation).

Extraction well locations, including the vertical location of the screened interval, will be selected to maximize mass removal by extracting groundwater from portions of the aquifer with the highest contaminant concentrations and to support plume containment. The proposed well field of seven extraction wells includes two wells for the U Plant plume area, two wells for the southeast chromium plume area, and three wells for the WMA S-SX plume area (the three WMA S-SX wells were installed and have been operating since 2012). Injection well locations were selected to optimize for flow-path control or hydraulic containment of the iodine-129 plume. The proposed well field of seven injection wells includes two wells for the U Plant plume area, two wells for the southeast chromium plume area, and three wells for the iodine-129 plume. Based on aquifer hydraulic properties and anticipated well screen lengths, it is estimated that individual well flow will typically be less than 379 L/min (100 gpm).

3.2.1 Well Design

Well designs are specific to their function and local geohydrologic conditions. Site-specific design considerations for the extraction wells include the following:

- Vertical distribution of contamination
- Expected flow rate and associated capture area
- Grain-size analysis of the aquifer matrix

Investigations in the 200-UP-1 OU identified that the vertical extent of contamination ranges from the top to the base of the unconfined aquifer in the Ringold Formation, depending on the plume. The smaller technetium-99 and uranium plumes are primarily located with the upper unconfined aquifer, while the larger plumes of tritium, iodine-129, chromium, and nitrate are believed to extend the full depth of the unconfined aquifer, particularly downgradient from the sources (see Appendix A). Extraction wells will be designed with filter pack and well screens to optimize plume capture while minimizing the extraction of clean groundwater. This approach will maximize contaminant mass removal from the aquifer while operating within the design flow rates of the system. Extraction well screen intervals will be determined in the field based on the encountered hydrogeologic conditions and the vertical distribution of contamination in the extraction well borehole. Well screens will typically be installed in sections of the extraction well borehole exhibiting groundwater concentrations that exceed cleanup levels. Well drilling, sampling, and completion requirements will be defined in the SAP as discussed in Section 2.4.1.

3.3 Treatment System Conceptual Design

This section discusses various aspects of the treatment system design. Table 3-4 provides a list of the 200-UP-1 OU P&T components.

Table 3-4. 200-UP-1 OU P&T Components

Location	COCs	Expected Well Field	200 West Groundwater Treatment Facility
WMA S-SX area	Technetium-99, nitrate, chromium, and carbon tetrachloride	Three extraction wells, total flow of 80 gpm for 15 years	Currently being treated at the P&T flowing through the IX and biological processes
U Plant area	Uranium, technetium-99, nitrate and carbon tetrachloride	Two extraction wells and two injection wells, average flow of 150 gpm for 25 years	Will be treated in sequence through the following processes; uranium IX, technetium-99 IX, and biological process, followed by air stripping
Southeast chromium plume area	Chromium	Two extraction wells and two injection wells, average flow of 200 gpm for 25 years	Will be treated through the biological treatment process
Iodine-129 hydraulic containment	Iodine-129 (no treatment)	Three injection wells for hydraulic control, 50 gpm per well	200 West P&T will return 150 gpm of treated water for hydraulic control

COC = contaminant of concern

P&T = pump-and-treat

gpm = gallons per minute

WMA = waste management area

IX = ion exchange

3.3.1 Summary of Treatment Needs

The 200 West Groundwater Treatment Facility became operational in late June 2012 with a design capacity of 9,464 L/min (2,500 gpm), treating COCs similar to those present in the 200-UP-1 OU plume (except for uranium). The 200 West Groundwater Treatment Facility has the following unit operations: (1) IX treatment for technetium-99; (2) biological treatment for nitrate, carbon tetrachloride, and chromium; and (3) air stripping for volatile organic compounds (VOCs), including carbon tetrachloride. The sludge generated from the biological treatment process is treated by lime stabilization, with emissions treated through an odor-control scrubber. Air emissions from the various unit operations are controlled using VPGAC roll-off containers discharging through a common stack. The radiological treatment is contained in one building, while the biological treatment is contained in a separate building with an outdoor equipment pad. The outdoor sludge treatment facility is located east of the biological treatment building.

The 200 West Groundwater Treatment Facility is also supported by a series of extraction wells and injection wells, aboveground conveyance piping, two extraction transfer buildings (ETB-1 and ETB-2), and two injection transfer buildings (ITB#1 and ITB#2). The 1,893 L/min (500 gpm) injection well field (from the former treatment facility) is also operational through ITB#2. Thus, the 200 West Groundwater Treatment Facility has the unit operations to treat the various 200-UP-1 OU COCs (technetium-99, total and hexavalent chromium, carbon tetrachloride, and nitrate), except for uranium. The operational lifetime

for the facility is 25 years similar to the requirements for the 200-UP-1 OU. The conceptual block flow diagram (Figure 2-2) includes the operations related to the treatment of the 200-UP-1 OU COCs.

The estimated additional treatment capacity for the 200 West Groundwater Treatment Facility associated with 200-UP-1 OU effluent is 1,628 L/min (430 gpm), with 568 L/min (150 gpm) of treated effluent being returned for hydraulic control of the iodine-129 plume.

3.3.2 Radiological Treatment Building Modifications

The radiological building includes two nominal, 1,136 to 1,514 L/min (300 to 400 gpm) IX trains for treatment of technetium-99. The treatment of 200-UP-1 OU effluent will require the addition of a uranium IX train, as well as the possibility of an additional IX treatment train for technetium-99. Space is available in the radiological building for both of these new trains. Supporting operations in the radiological building include the following:

- Technetium-99 influent tank from ETB-2
- Bag filters prior to IX columns
- Resin slurry and feed system
- Hot water rinse tank to remove volatiles from spent resin
- Pumps to convey water through the IX columns and into the effluent tank for the biological process
- Resin dewatering system used to place water in lined wooden boxes for disposal
- Personal count monitor, two hand and foot monitors, and a radiological change room

Floor trench drains are already provided to support the installation of these additional trains. In addition to adding the new IX train(s), the following considerations will need to be confirmed and/or addressed:

- Confirm that the current hoist, bag unloading station, and slurry tank can support operation of the two new trains. Indications are that this is feasible since the rate of resin consumption for technetium-99 is expected to be lower than anticipated.
- Confirm that the hot water soak tank can also support the two new trains. Due to the low resin usage rate, this is expected to be feasible.
- Size and install a uranium influent tank for the uranium IX train, including necessary piping and pumps.
- Confirm that space is available for the uranium IX train without the need to relocate the portable radiological change room.
- Determine if chemical feed is required for pH adjustment of the influent to the uranium IX train.
- Confirm that sufficient electrical power is present or that cables can be pulled to support the installation.
- Detail the instrumentation and control terminations required to the human/machine interface in the existing control room, and from the 200-UP-1 transfer buildings to the control room and programmable logic controllers (PLCs) in the radiological building.

3.3.3 Biological Treatment Plant Modifications

The general biological process uses fluidized bed reactors (FBRs) and membrane bioreactors (MBRs) to treat nitrate, chromium, carbon tetrachloride, and other associated contaminants. The two parallel, 4,732 L/min (1,250 gpm) biological trains each have one FBR and carbon separation tank and two MBRs.

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The effluent from the biological process passes through air strippers prior to discharge to an effluent tank, to support pumping of the treated water to the transfer buildings for discharge into the injection well field. Sludge from the biological process is treated through three rotary drum thickeners and two centrifuges prior to treatment through the sludge stabilization system, which mixes the sludge using a pug mill with lime prior to loadout and disposal at the ERDF. Off-gas from the biological treatment process is treated through roll-off containers of VPGAC prior to discharge to the atmosphere. Off-gases from the sludge stabilization system is treated through an odor control scrubber.

As a part of the design basis, the 200 West Groundwater Treatment Facility was constructed with space remaining for the addition of a third biological train, including the following: one FBR and carbon substrate tank, two MBRs, one air stripper, two VPGAC roll-off containers, and ancillary equipment. The following existing systems are sized to handle the expansion of the third train:

- Three rotary drum thickeners
- Two centrifuges
- Lime stabilization system
- VPGAC system (except for addition of two roll-off containers)
- Common treated outlet stack
- Effluent and influent tankage
- Main plant electrical transformer and power distribution system
- Lime storage capacity in the two 60-ton silos
- Carbon substrate and sulfuric acid tankage
- Existing injection pump system to the transfer buildings (although some minor modifications may be required)
- Overhead bridge crane
- Splitter structure (splits flow from FBRs to MBRs)

The following general requirements would need to be evaluated and/or confirmed:

- Confirm that sufficient chemical storage and feed are available. Preliminary indications are that sufficient chemical feed and storage capacity exist for the MBR, but not for the FBR and the air stripper. Additional chemical metering equipment may then be required.
- Determine whether the two 100 percent screw air compressors and receiver system can provide sufficient air for the third train.
- The treated water tank may require an additional set of pumps to convey treated water to the iodine-129 injection wells for hydraulic control. This would include an additional set of transfer pumps and piping, unless there is remaining pumping capacity in ITB#1 that could be effectively used. The additional set of pumps could also be installed in ITB#1.
- Instrumentation and controls would need to be run to the control room.

- Human/machine interface capacity would need to be evaluated, as well as additional programming requirements. Local PLCs would also need to be evaluated to determine if sufficient capacity is present.

3.3.4 Modification of the Treatment Facility

It is expected that no major modifications or additional footprint would be required at the 200 West Groundwater Treatment Facility. As discussed above, space remains available for equipment associated with the addition of a third biological train. Major pieces of equipment (e.g., the FBR and MBR support pumping skids) that require placement in the biological building can be placed on rollers and then jacked and set in place. The FBR, carbon substrate, and MBR tankage can be placed by crane on the containment pad, as well as the air stripper, although in some cases it may be necessary to remove or work around some pipe racks and access platforms. The two VPGAC roll-off containers can be placed by a roll-on/roll-off trailer.

During modifications, it is anticipated that multiple plant shutdowns or reductions in capacity would be necessary (e.g., running both trains at partial capacity, running only one train, or shutdown or minimizing operations of supporting unit operations [rotary drum thickener, centrifuges, etc.]). These constructability issues will be evaluated as a part of the design phase.

The work areas at the treatment facility may be amenable to multiple work zones. Major work zones include the following:

- **IX trains:** The physical setting of this equipment and associated work will likely not interfere with plant operations, although the interconnections would require coordination.
- **FBR and MBR skids:** The physical setting of this equipment and associated work will likely not interfere with plant operations, although the interconnections would require coordination.
- **Outdoor equipment on pad (FBR, carbon separation tank, MBR, and air stripper):** Setting of this equipment will require a detailed evaluation of interferences and evaluation of whether the localized equipment (and, in some cases, the plant) can remain operational due to combination of safety and operational issues.
- **Transfer building:** The transfer building will be located at new sites, so there should be no interferences for their construction only coordination with interties to the treatment facility.

Additional high-density polyethylene (HDPE) conveyance piping and fiber optic communication cable will be laid from the transfer building(s) to the 200 West Groundwater Treatment Facility. Fiber optic communication cable will also be laid from the various extraction wells to the transfer buildings. Incoming conveyance piping from the transfer building(s) would enter the facility through the northwestern concrete pipe vault and aboveground structural steel pipe conveyance structure. It will need to be confirmed if sufficient penetrations exist for the number and diameter of the 200-UP-1 conveyance piping. Pipe routing will need to be determined for the HDPE injection water conveyance piping to the iodine-129 plume injection wells. The sufficiency of the fiber optic or radio communication system will need to be evaluated for the injection well communications between the well rack and human/machine interface.

3.4 Well Field and Transfer Building Conceptual Design

A conceptual layout of the balance of plant (consisting of the necessary piping and structures to connect the extraction and injection wells to the treatment facility) is shown on Figure 3-4. Water from each extraction well will be conveyed to a transfer building using aboveground pipelines. The water will then

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be transferred to the 200 West Groundwater Treatment Facility using aboveground pipelines. Treated groundwater will be returned to the aquifer using aboveground pipelines, transfer building, and injection wells. Existing transfer buildings will be used to the extent practical.

The location of the 200-UP-1 OU extraction and injection well field is shown on Figure 2-1. The conveyance distances are up to 4.6 km (2.9 mi) for the southeast chromium plume, and the long conveyance distance would typically require the use of transfer buildings. The number of required transfer buildings will be established as part of remedial design. As previously indicated, the WMA S-SX conveyance system is already operational at the radiological building, with conveyance through the WMA S-SX transfer building (ETB-3).

The transfer piping will be aboveground, fusion-welded HDPE running through a combination of new and existing piping routes and road crossings. Fiber optic communication cable will follow the pipe runs. Piping and fiber optic cable will run from the extraction wells and to the transfer buildings, as well as from the transfer buildings to the 200 West Groundwater Treatment Facility. Individual extraction well conveyance piping will have sample points in the transfer buildings.

Hydraulic analysis will be conducted to size the well extraction pumps, which will convey the water from the well to a particular transfer building as needed. Pumps in the transfer buildings and conveyance piping would be sized to convey extracted groundwater to the 200 West Groundwater Treatment Facility. For groundwater with elevated technetium-99 and uranium concentrations that requires treatment, the extraction transfer building may be equipped with a separate transfer system tank and pumps for the radionuclide-contaminated water. This transfer system will provide a dedicated piping system to allow for pre-treatment of the elevated radionuclide contamination before undergoing chemical treatment at the treatment facility. Temperature profiles and analysis will be evaluated for the conveyance piping to meet design temperature requirements, including freezing during winter months and summer weather conditions. Transfer building conveyance piping to the 200 West Groundwater Treatment Facility will typically have a much higher flow than the piping from the extraction wells to the transfer buildings and, as such, are less susceptible to freezing during the winter months. Transfer piping is expected to be single-wall HDPE installed above grade, except for road crossings. Leak detection in the above grade piping will be primarily provided through inspections, or as otherwise provided in the RDR. Double-wall HDPE piping may be used for freeze-protection purposes if needed (e.g., for low flow rates and/or long pipeline distances).

The southeast chromium plume is the most distant plume that will undergo P&T and will require long pipeline and electrical runs to convey groundwater to the 200 West Groundwater Treatment Facility. Alternate approaches to treat the chromium plume (e.g., a smaller onsite treatment system) will be considered during the remedial design process.

3.5 Design Approach

The remedial design process will be performed in a phased manner (30 percent, 60 percent, and 90 percent designs). Upon completion of 30 and 60 percent design, EPA will be briefed on the progress of the remedial design and solicited for informal comments to be incorporated into subsequent design efforts.

The 90 percent design will be summarized in the RDR, as discussed in Section 3.5.1. The RDR will be provided to the lead regulatory agency for review and approval. Following approval of the RDR, the procurement and construction of the remedy system can commence. The final 10 percent of design is completed during (field changes) and after (as-building) construction prior to facility turnover to operations.

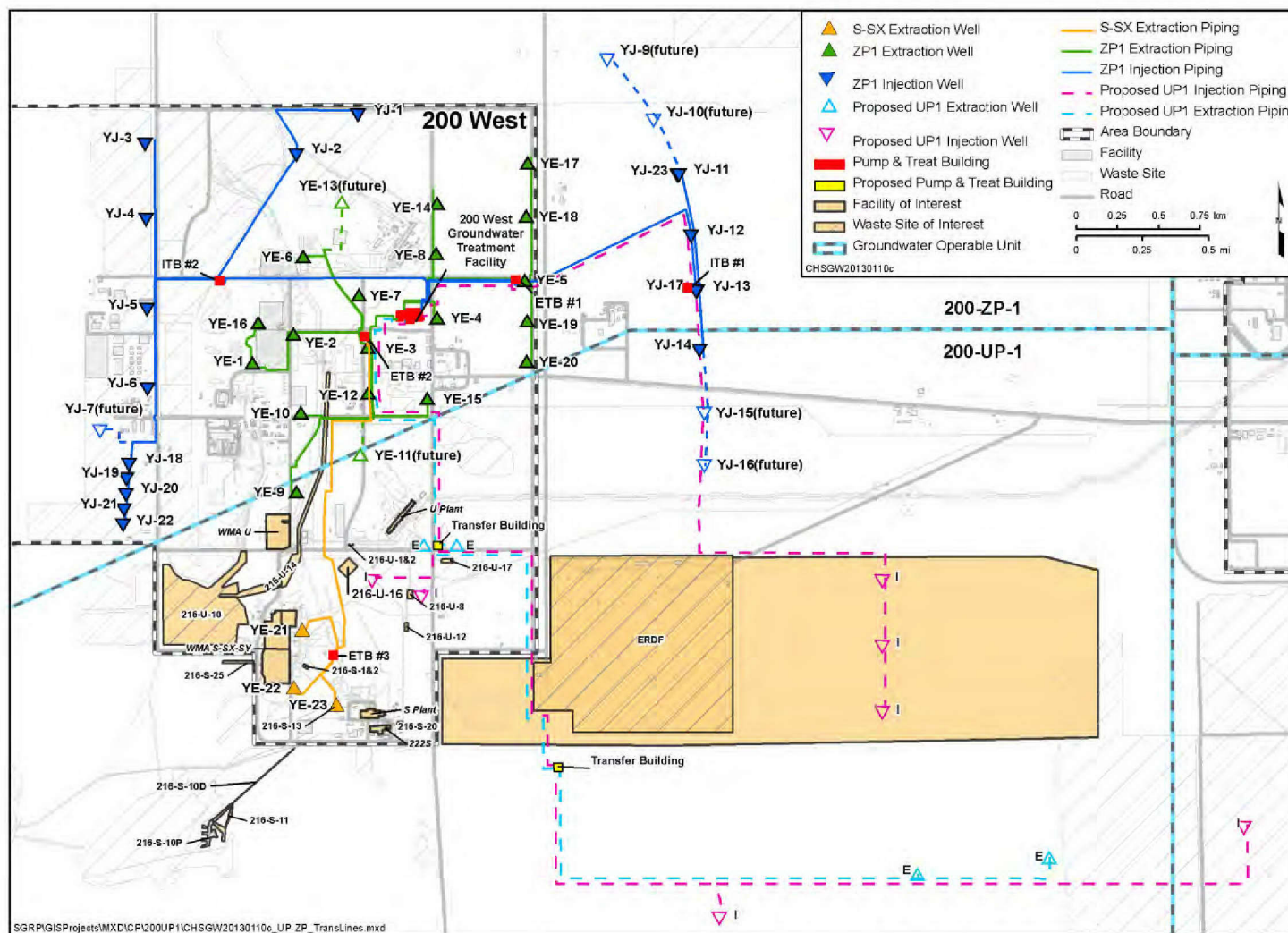


Figure 3-4. Conceptual Layout of Transfer Pipelines, Transfer Buildings, and Associated Extraction and Injection Wells for the 200-UP-1 OU Remedy

The following subsections describe documents that will be produced as part of the remedial design effort, which include the RDR (Section 3.5.1), the O&M plan (Section 3.5.2), the PMP (Section 3.5.3), and the iodine-129 technology evaluation plan (Section 3.5.4). Section 3.5.5 addresses characterization needs for the southeast chromium plume to support remedial design of the P&T system that will be further defined in the PMP.

Adjustments to the system design and operating parameters will occur throughout the lifecycle of this project based on actual system performance against the RAOs.

3.5.1 Remedial Design Report

Per Section 7.3.9 of the Tri-Party Agreement Action Plan (Ecology et al., 1989b), DOE will submit a RDR to EPA. The RDR will contain, or include by reference, the following items:

- 90 percent remedial design:
 - Functional requirements document
 - Functional design criteria
 - Drawings, specifications, and calculations
 - Process flow diagrams
 - Piping and instrumentation diagrams
 - Site plan including locations of wells and transfer buildings, and pipeline alignments
- Results of recent studies and analyses as input to the design basis:
 - Groundwater modeling and plume capture analysis
 - Methodology for calculation of UCL95 on a routine basis to support remedy optimization
 - Engineering analysis to assess the need for a third technetium-99 and/or biological treatment train
 - Hazard analysis
 - Process influent chemistry
- Identification of long lead procurements
- Construction budget estimate
- Preliminary construction schedule.

The RDR will focus on the U Plant area and iodine-129 plume remedies, and it will include a 90 percent level of design for these plume areas. The remedial design of the southeast chromium plume area will be initiated following the completion of the southeast chromium plume characterization effort (discussed in Section 3.5.5). Following the southeast chromium plume remedial design effort, the RDR will be revised with an addendum or other documentation agreed to by EPA. The RDR will be submitted to the EPA for review as a primary document in accordance with the Tri-Party Agreement, Section 9.2.1 (Ecology et al., 1989a).

3.5.2 Operations and Maintenance Plan

The O&M of the 200-UP-1 P&T system will be integrated with the 200 West P&T, as both remedial actions will share a common treatment facility. The 200 West Groundwater Treatment Facility was constructed under the 200-ZP-1 OU remedial action and sized to accommodate the 200-UP-1 OU remedial action. The following O&M plans will be updated to incorporate the 200-UP-1 P&T system:

- **200 West Area Pump-and-Treat Facility Operations and Maintenance Plan (DOE/RL-2009-124):**
This plan outlines the activities necessary to operate, maintain, and monitor performance of the

200 West P&T and associated pumping system for the time frame from completion of construction through decommissioning. The WMA S-SX extraction wells, pipelines, and transfer buildings are currently managed under this O&M plan.

- **200 West Area Groundwater Pump-and-Treat Facility Extraction and Injection Well Maintenance Plan (DOE/RL-2010-78):** This plan defines the activities necessary to maintain and monitor performance of the 200 West P&T's extraction and injection wells. The WMA S-SX extraction wells are currently managed under this plan.

Process monitoring (e.g., well flow rates, water levels, and COC concentrations) involving extraction/injection wells and 200 West Groundwater Treatment Facility performance will be defined in the O&M plans, as discussed in Sections 2.1.4, 2.4.1, and 2.4.2. Process control monitoring includes measurement of extraction/injection well flow rates and water levels, radiochemistry of extracted groundwater and the performance of the 200 West Groundwater Treatment Facility. Process monitoring data will be used to assess contaminant mass removal and treatment effectiveness. Because process control monitoring requirements will be determined as part of remedial design, updates to the O&M plans will occur following remedial design. Process monitoring will be reported annually in coordination with the 200-ZP-1 OU or defined in the O&M plan. The O&M plan is a primary document, as described in Section 7.3.11 of the Tri-Party Agreement Action Plan (EPA et al., 1989b), and any revision requires lead regulatory agency review and approval.

3.5.3 Performance Monitoring Plan

Remedy performance monitoring will be conducted over the lifetime of the interim remedial action to evaluate its performance and optimize effectiveness. A PMP will be developed that defines the requirements for aquifer performance monitoring. This will include water-level measurements, and groundwater sampling and analysis of monitoring wells to assess changes in contaminant plume geometry, MNA performance, and the effectiveness of hydraulic controls, and to calculate changes in the UCL₉₅ for individual COCs as a measure of cleanup progress. Additional discussion of the scope of the monitoring program is provided in Sections 2.1.4 and 2.4.3.

The PMP will address the following:

- A routine groundwater well sampling and analysis program that will supersede all previous 200-UP-1 OU groundwater monitoring plans
- Hydraulic monitoring of water levels
- A SAP defining monitoring well locations, and the types and frequency of data to be collected, with the expectation that existing monitoring well network will be used to the maximum extent possible
- Recommendations for installation of new monitoring wells in areas of the 200-UP-1 OU where monitoring control is lacking or deficient
- Establishment of a baseline to be used for measuring performance and criteria for determining when active treatment can be shut down
- Methodology and data for calculating the UCL₉₅ statistic
- Routine reporting requirements

The PMP will be submitted to EPA for review as a secondary document. The SAP contained in the PMP will require approval by the lead regulatory agency. Following completion of the PMP, performance

monitoring activities will be implemented. Select activities (e.g., drilling of monitoring wells) may be initiated prior to completion of the PMP with concurrence of the lead regulatory agency. Prior to completion of the PMP, groundwater monitoring at 200-UP-1 OU will continue following the sampling schedule provided in Appendix B. Appendix B includes a table of groundwater sampling activities by well that is used to track changes in the groundwater plumes during this interim period and to provide current groundwater data for remedial design.

3.5.4 Iodine-129 Technology Evaluation Plan

The ROD requires that DOE evaluate potential treatment options for iodine-129 as part of the selected remedy through further technology evaluation. An iodine-129 technology evaluation plan will be prepared to outline the study approach and provide an updated feasibility analysis of potential treatment options. The feasibility analysis will evaluate available iodine-129 treatment options based on cost, effectiveness, and implementability to identify viable options. A viable option would be cost effective and implementable. The plan will also summarize relevant performance data from the 200 West Groundwater Treatment Facility, if available. The plan will be subject to review and approval by the lead regulatory agency. If one or more viable technologies are identified as a result of the feasibility analysis, treatability testing may be required to evaluate the technology or process options in more detail and would be conducted in accordance with a treatability test plan.

DOE is currently evaluating a suite of resins, as well as, the performance of the 200 West Groundwater Treatment Facility with regard to I-129 removal efficiency. These evaluations are planned to be complete in FY14, at which time EPA will be briefed on the results. The information gained from these activities, in consultation with EPA, will be used by DOE as input to focus the scope of the I-129 Technology Evaluation Plan.

3.5.5 Southeast Chromium Plume Characterization

The extent of the groundwater chromium plume in the southeastern portion of the 200-UP-1 OU is shown on Figure 1-3 and is further discussed in Appendix A. The footprint and cross section of the chromium plume are primarily based on data from monitoring wells 699-30-66, 699-32-62, and 699-33-56 (Appendix A, Figure A-11). Relatively few monitoring wells are available in the area to define the vertical and horizontal extent of this plume. While the analysis provided in the 200-UP-1 OU RI/FS (DOE/RL-2009-122) showed that the plume extents are defined conservatively, defining the three-dimensional plume configuration based on a limited spatial dataset results in a large degree of uncertainty. In addition, a limited dataset does not provide a robust statistical analysis necessary for reliable calculation of the UCL₉₅ used for comparison to cleanup standards.

Additional characterization will be performed to refine the plume geometry of the southeast regional chromium plume to focus and optimize the remedial design. Wells will be drilled and sampled in the area of the southeast chromium plume to collect the necessary data. The data quality objective (DQO) process will be used to define the final number, location, and type of wells, as well as the measurement frequency. Consideration will be given to sampling groundwater over the entire depth of the aquifer to understand the vertical distribution of concentrations and to select an appropriate screened interval. The flexibility of completing the wells for dual use (monitoring well or extraction/injection well) will also be considered. The results of the DQO process will be documented in a SAP as part of the PMP.

4 Remedial Action Approach and Management

This chapter describes implementation of the selected remedy to accomplish the remedial goals set forth in the 200-UP-1 OU ROD (EPA et al., 2012). It includes a discussion of the management team, facility procurement and construction approach, and the operational approach. Operation of the new 200-UP-1 P&T remedies and the existing 200 West P&T will be combined into an integrated P&T system (using the treatment capacity of the 200 West Groundwater Treatment Facility), which will be described in the O&M plan.

4.1 Project Team

The term “project team” includes the individuals working to accomplish the 200-UP-1 OU remedial action. Accordingly, the project team includes the lead regulatory agency, RL, and the remediation contractor (CHPRC).

4.1.1 Lead Agency (U.S. Department of Energy)

DOE is the lead agency under CERCLA (delegated by Executive Order 12580, *Superfund Implementation Plan*, the primary authority under Section 104 and 121) to conduct removal and remedial actions at DOE facilities. DOE is responsible for the remedial actions throughout the Hanford Site and, as such, has assigned remedial project managers to each main area and task involved with remediation activities. The lead agency is responsible for managing the assigned activities including scope, budget, schedule, quality, personnel, communication, risk/safety, contracts, and regulatory interface, and works under EPA oversight in accordance with CERCLA Section 120, as implemented through the Tri-Party Agreement (Ecology et al., 1989a). DOE obtains Congressional funding for these functions.

4.1.2 Lead Regulatory Agency (U.S. Environmental Protection Agency)

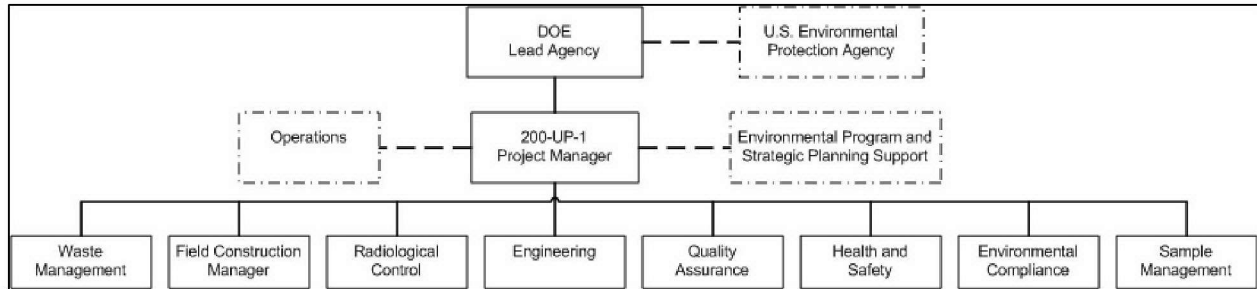
The EPA is the lead regulatory agency for CERCLA remediation activities at the 200-UP-1 OU. The lead regulatory agency is responsible for overseeing activities to verify that applicable regulatory requirements are met. Lead regulatory agency approval will be required on all SAPs and Tri-Party Agreement primary documents (e.g., this RD/RA work plan, RDR, and O&M plan).

4.1.3 Remediation Contractor (CH2M HILL Plateau Remediation Company)

On October 1, 2008, CHPRC assumed the contract with DOE to perform remedial actions at the 200-UP-1 OU. CHPRC performs work under direction of the DOE remedial project manager, assisted by other DOE personnel, as outlined in the following descriptions and shown on Figure 4-1.

4.1.3.1 Project Manager

The 200-UP-1 OU project manager, under the CHPRC Soil and Groundwater Remediation Project (S&GRP), provides oversight for all activities and coordinates with RL, the regulators, and primary contractor management in support of remediation activities. The project manager ensures that the field construction manager, environmental compliance officer, sampling coordinator, and others responsible for implementation of regulatory documents are provided with current copies of these documents and any revisions thereto. The project manager also works closely with the Quality Assurance (QA), Health and Safety, Remediation Support (drilling/sampling) and Operations organizations, and the field construction manager and engineering lead to integrate these and other lead disciplines in planning and implementing the work scope. The project manager also coordinates with and reports to RL, the regulators, and the remediation contractor management on remediation activities.

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4.1.3.2 Engineering

All engineering and design work will be performed by qualified engineering staff in accordance with the remediation contractor's engineering procedures (or equivalent standards) using a graded approach. The initial design will be documented in the RDR, as described in Section 3.5. The project engineer or engineering lead will be responsible for the remedial design and associated interfaces with the Operations, QA, and Health and Safety organizations.

4.1.3.3 Operations

Operations include operating personnel, field engineering, procurement, and maintenance. Operations ensure that the facility and systems are operated and maintained in accordance with applicable requirements and procedures while safely meeting production goals. Responsibilities include P&T system operations, process control, sampling, configuration and work control, modification to systems/facilities, corrective and preventive maintenance, waste management, and support to new system/facility construction, testing, and startup. Operations personnel will be an integral part of the design process, including participation in design reviews and reviews of the associated drawings and specifications.

4.1.3.4 Quality Assurance

The QA lead is matrixed to the 200-UP-1 OU project manager and is responsible for QA issues on the project. Responsibilities include overseeing implementation of the project QA requirements; reviewing project documents (including DQO summary reports, SAPs, and the QA project plan); and participating in QA assessments on sample collection and analysis and other remediation activities, as appropriate. Construction QA personnel will be assigned to the project to oversee the construction and vendor fabrications, including development of QA inspection plans for the vendor-fabricated equipment.

4.1.3.5 Health and Safety

The Health and Safety organization's responsibilities include coordinating industrial safety and health support within the project as carried out through health and safety plans (HASPs), job hazard analyses, and other pertinent safety documents required by federal regulations or by primary remediation contractor work requirements. In addition, assistance is provided to project personnel in complying with applicable health and safety standards and requirements. Personnel protective clothing requirements are coordinated with the Radiological Control lead. The Industrial and Health and Safety leads will participate in the development of the functional design requirements, as well as the review of drawings and specifications.

4.1.3.6 Field Construction Manager

The field construction manager will be responsible for the construction phase of the project, including the management of CHPRC onsite forces, as well as subcontractors and vendors provided work (including offsite fabrications). Responsibilities include the day-to-day management of necessary site

resources while maintaining the budget and schedule. Support organizations will include Industrial Safety, Health and Safety, environmental compliance, QA, sampling, Waste Management, and Radiological Control staff in the planning, coordination, and execution of field remediation activities. The field construction manager communicates with the 200-UP-1 OU project manager to identify field constraints that could affect remediation activities as well as assisting the construction manager in obtaining supporting resources.

4.1.3.7 Environmental Program and Strategic Planning

The Environmental Program and Strategic Planning organization provides support during the development of required regulatory documents. This includes groundwater modeling in support of remedial design and remedy performance evaluation.

4.1.3.8 Environmental Compliance

The environmental compliance officer provides technical oversight, direction, and acceptance of project and subcontracted environmental work and also develops appropriate mitigation measures, with the goal of minimizing adverse environmental impacts. The environmental compliance officer also reviews plans, procedures, and technical documents to ensure that all environmental requirements have been addressed; identifies environmental issues that affect operations and develops compliant and cost-effective solutions; and responds to environmental/regulatory issues or concerns raised by RL and/or the regulatory agencies.

4.1.3.9 Radiological Control

The Radiological Control lead is responsible for the radiological/health physics support within the project. Specific responsibilities include conducting as low as reasonably achievable (ALARA) reviews, exposure and release modeling, and radiological controls optimization for all work planning. In addition, radiological hazards are identified and appropriate controls are implemented to maintain worker exposures to hazards at ALARA levels (e.g., personal protective equipment). The Radiological Control organization interfaces with the project Health and Safety representative and plans and directs radiological control technician support for all activities. The Radiological Control lead will also assist in construction activities (mostly interconnections) that require access to operational piping.

4.1.3.10 Waste Management

The Waste Management lead communicates policies and procedures, and ensures project compliance for storage, transportation, disposal, and waste tracking in a safe and cost-effective manner. Other responsibilities include identifying waste management sampling/ characterization requirements to ensure regulatory compliance and interpreting the characterization data to generate waste designations, waste profiles, and other documents that confirm compliance with waste acceptance criteria.

4.1.3.11 Sample Management

Sample Management coordinates laboratory analytical work, ensuring that the laboratories conform to Hanford Site internal laboratory QA requirements (or their equivalent), as approved by DOE and EPA. Sample Management receives the analytical data from the laboratories, performs data entry into the Hanford Environmental Information System database, and arranges for data validation. Sample Management is responsible for informing the project manager of any issues reported by the analytical laboratory, and also works with the project manager to prepare characterization reports on the sampling and analysis results, as needed. Additional related responsibilities include developing the DQOs and SAP, including the sampling design, coordinating field sampling, and resolving technical issues.

4.2 Change Management

Three types of changes in the 200-UP-1 OU remedial action could affect compliance with the requirements in the 200-UP-1 OU ROD: (1) a nonsignificant or minor change, (2) a significant change to a component of the remedy, and (3) a fundamental change to the overall remedy.

A nonsignificant or minor change does not impact the remedy identified in the 200-UP-1 OU ROD (EPA et al., 2012). An example of a nonsignificant change may include modifications to the remedial action schedule that do not impact an agreed-upon milestone. Minor changes should be documented in the appropriate post-decision project file (e.g., through interoffice memoranda or in logbooks) or project manager's meeting minutes.

It may be determined that a significant change to the selected remedy, as described in the 200-UP-1 OU ROD, is necessary. Significant changes are defined as changes that significantly modify the scope, performance, or component cost for the remedy as presented in the ROD. All significant changes will be addressed in an explanation of significant differences. Examples of significant changes may include, but are not limited to, the following:

- A significant increase (greater than +50 percent) or decrease (more than –30 percent) in the total cost of site remediation
- A significant delay in the point in time when the remedial actions or objectives are met

A fundamental change is a change that does not meet the requirements set forth in the 200-UP-1 OU ROD or that incorporates remedial activities not defined in the scope within the ROD. Should this situation arise, the ROD must be amended. Significant changes that fundamentally alter the remedy occur when the following situation occurs:

- The addition of contaminated groundwater for remedial action under the 200-UP-1 OU ROD that requires additional remedial action above that identified in the ROD.

Determining whether a change is significant or fundamental is the lead regulatory agency's responsibility. The project manager is responsible for tracking all changes and obtaining appropriate reviews by staff. The project manager will discuss the changes with the lead agency, followed by discussions with EPA.

4.3 Facility Procurement and Construction

4.3.1 Procurement Approach

This remedial action involves modification to the existing treatment facility, and new construction including the installation of monitoring, extraction and injection wells, and the necessary infrastructure to transport water from the extraction wells to the treatment system and finally back to the injection wells. This work scope will be accomplished using the most efficient combination of onsite resources, as well as design and construction services vendors and subcontractors. It is anticipated that a "bid/build" or a "design/self-perform" approach may be used. The decision will be based on cost and the ability to meet the project schedule.

4.3.2 Long-Lead Procurement

To maintain schedule, several long-lead items are anticipated to be procured prior to completing the remedial design and provided as government-furnished equipment to the installation subcontractor, if applicable. Procurement of these items will be in accordance with an engineering specification, which will identify the requirements for each piece of equipment. The equipment specification will be included

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in a procurement package sent to qualified vendors to supply the particular piece of equipment. The bids received from qualified vendors will be evaluated, and a purchase order will be released to the selected vendor. Anticipated long-lead procurement items would include the following:

- FBR system, including carbon separation tank
- IX system(s)
- MBR system
- Air-stripper system
- Pump/tanks system

4.3.3 Construction

Facility construction will be performed in accordance with the drawings and specifications provided in the remedial design package. Remediation contractor oversight will be onsite during all construction activities to ensure compliance with the drawings/specifications and to address field questions from the vendor. Changes to the design will be documented using construction change control and discussed with RL and EPA during regular project status meetings. The construction effort will be managed using a detailed, critical path schedule that is based upon the schedule provided in the RDR. Construction will be implemented in a sequenced approach by plume area (as discussed in Section 3.1.1). To meet the schedule, long-lead items may be procured early (discussed in Section 4.3.2). To install the necessary monitoring, extraction, and injection wells, well drilling is expected to begin early during the remedial action.

A mobilization period will be used to prepare subcontractors, site workers, and support personnel for construction. This period will include the subcontractor providing insurance certificate and proof of bonding, as well as providing other documentation certifying compliance with training, medical, safety, and quality requirements. The mobilization period will be used by subcontractors, site workers, and support personnel to prepare for construction activities, and it will include such activities as the following:

- Identification of work zones, lay down areas, and staging areas
- Erection of fences, signs, and postings
- Delivery and storage of construction materials and equipment

Minimum modifications to the 200 West Groundwater Treatment Facility will include the installation of an IX treatment train to treat uranium. Other modifications, to be determined during design, may include an additional technetium-99 IX treatment train and biological process treatment train. Costs for construction of the additional technetium-99 IX and uranium IX treatment trains are included in the estimate provided in Table 7-1 under the U Plant area plume. Costs for construction of the additional biological process treatment train are not included in the estimate at this time. The cost estimate will be updated as part of the RDR effort, if it is determined that a third biological process treatment train is required.

Generally, construction will begin with performing the civil site work (e.g., site preparation, grading and compaction, running utilities, etc.). This is followed by construction of the surrounding pads, structures, utility connections, and installation road crossings, piping, and pumping systems. The construction period also includes the drilling, sampling, completion and hook-up of extraction and injection wells.

Following construction, compliance with the design requirements will be performed as part of plant startup.

4.3.4 Plant Startup

A startup plan and transition plan will be prepared to support startup of the new components associated with the 200-UP-1 remedy. These plans will discuss the performance of construction acceptance testing and the acceptance testing procedure, as well as the operational test procedure, which is implemented upon turnover of the 200-UP-1 additions from the contractor to Operations. This procedure will be executed as construction is completed and will provide documentation that all systems and major equipment have been installed and perform as intended, after which time the systems will be turned over to Operations.

4.4 Operational Approach

This section includes the operational approach for facility startup and for operation of the P&T system.

4.4.1 Facility Startup

Following acceptance testing, the treatment facility modifications and balance of plant components will be formally turned over to the S&GRP Operations group. The first activity during initial operations will be to complete the actions identified in the operational testing plan. These actions will include final operability testing and system interface with facility operators. During this phase, all facets of the system will be cyclically started, operated, and shut down for training purposes. Procedures that were drafted prior to turnover will be used and refined. Preventive maintenance procedures (also developed prior to turnover), including equipment and instrument calibrations, will be performed where necessary and procedures refined as needed.

Facility operators and maintenance personnel will spend time in the facility familiarizing themselves with the equipment, systems, procedures, and interfaces. It is expected that minor modifications and maintenance will be necessary as the equipment and systems are run-in. Safety, radiation control, and waste management programs will be implemented and verified as operational. Upon completion of operational testing, the facility will transition to long-term operations.

4.4.2 Operations

Operation of the P&T system includes the O&M, engineering, and support functions that will continue throughout the lifecycle of the remedy. Operations activities include the operation and control of facility systems, training and qualification of operators to ensure depth of trained personnel, sample collection, emergency response, continuous improvement through lessons learned, and access control. Preventive, corrective, and modification maintenance will continue throughout this phase. Engineering evaluations and plant/system optimization will be an ongoing activity to continuously improve efficiency, reliability, and maintainability. Radiation control, industrial safety and hygiene, and waste management programs for long-term surveillance, oversight, and stewardship of the facility will be continuously updated as conditions change or as new activities warrant. Continuous feedback using tools such as management assessments, independent assessments, QA, and RL oversight will be in place throughout the lifecycle of the project.

Operation of the P&T system is expected to be dynamic to optimize contaminant recovery and system performance. As such, operations will adjust flow rates from individual wells and treatment components as necessary based on performance, which may include eliminating wells that have already achieved cleanup levels or identifying alternate extraction/injection wells. Operational changes will be documented in the operations log and will be discussed with RL and EPA during regular status meetings. Any new wells that require drilling and installation will be identified in the appropriate SAP.

4.5 Data Use and Interpretation

Remedy performance reports will demonstrate the progress in remediating the aquifer to meet the cleanup levels set forth in the 200-UP-1 OU ROD (EPA et al., 2012). The reports will also include information on treatment process effectiveness. Remedy performance reports will be produced annually for the first 2 years. The first report will serve as a baseline and template for further reports. Following this period, a decision will be made in regard to the frequency of further performance reports. If there appear to be substantial decreases or changes in concentrations of contaminants or plume area, then more frequent reporting may be appropriate. If the decrease in contaminant concentration appears to be gradual, then the frequency of reports may be decreased to a minimum of every 5 years to correspond with the CERCLA 5-year review.

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5 Environmental Management and Controls

This chapter describes the environmental management and controls associated with the implementation of the 200-UP-1 OU P&T system.

The 200 West Groundwater Treatment Facility will be used to treat extracted groundwater to DWSs as required by the 200-ZP-1 OU ROD (EPA et al., 2008) and 200-UP-1 OU ROD (EPA et al., 2012).

The COCs currently being treated at the 200 West Groundwater Treatment Facility are carbon tetrachloride, total chromium, hexavalent chromium, nitrate, trichloroethene, and technetium-99.

The 200-UP-1 OU ROD adds uranium as a COC, which will require modifications to the facility in order to treat this COC.

5.1 Air Emissions

Federal and state ambient air quality standards require that pollution control equipment be used to control emissions from new and existing sources. Because the 200 West Groundwater Treatment Facility has the potential to discharge hazardous air pollutants, an evaluation of air impacts was conducted in 2009 and is presented in the O&M plan for the 200 West P&T (Appendix C of DOE/RL-2009-124).

This analysis estimated the radionuclides concentrations, toxic air pollutants concentrations, and mass emissions that could potentially be emitted from operations at the constructed flow rate of 9,464 L/min (2,500 gpm) (two 4,732 L/min [1,250 gpm] trains). The analysis will be re-evaluated considering the additional 200-UP-1 OU streams and will be documented in an update to the 200 West P&T O&M plan. Extracted groundwater from the 200-UP-1 OU is expected to add an additional flow rate of 1,628 L/min (430 gpm).

The 200 West Groundwater Treatment Facility is currently in the planning stage for performing direct-emission, point-source testing. Source sampling on the major emission points in the facility is planned. The results of this testing will be applied to the emissions analysis and modeling evaluation for 200-UP-1 OU when the O&M plan is updated.

5.1.1 Radiological Air Emissions

RCW 70.94 (“Public Health and Safety,” “Washington Clean Air Act”) requires regulation of radioactive air pollutants. WAC 173-480 (“Ambient Air Quality Standards and Emission Limits for Radionuclides”) sets standards that are as or more stringent than the federal *Clean Air Act of 1990*, and under the federal implementing regulation, 40 CFR 61 (“National Emission Standards for Hazardous Air Pollutants,” Subpart H, “National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities”).

WAC 246-247 (“Radiation Protection – Air Emissions”) addresses potential radioactive airborne emissions from point sources and from fugitive or diffuse sources by requiring monitoring of such sources. Such monitoring requires physical measurement of the effluent or ambient air and QA measures to ensure the precision, accuracy, and completeness of environmental measurements. The substantive provisions of WAC 246-247 that require monitoring of radioactive airborne emissions would be applicable or relevant and appropriate to this remedial action. The above-stated implementing regulations further address control of radioactive airborne emissions where economically and technologically feasible (WAC 246-247-040[3] and –040[4], “General Standards”). To address the substantive aspect of these requirements and ensure ARARs compliance, best or reasonably achieved control technology will be addressed by ensuring that applicable emission control technologies (i.e., those successfully operated in similar applications) are used when economically and technologically feasible (i.e., based on cost/benefit) or ARARs waivers are agreed upon.

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The proposed remedial action will be evaluated with respect to determining the potential to emit for radionuclide contaminants from any point source or diffuse/fugitive source. To accomplish this, the total unabated potential release (in curies) will be determined, and the annual dose to the maximally exposed individual will be calculated using *Calculating Potential to Emit Radiological Releases and Doses* (DOE/RL-2006-29) or modeled using the CAP 88PC computer model.

5.1.2 Nonradiological Air Emissions

To demonstrate compliance with the ARARs listed in WAC 173-400 (“General Regulations for Air Pollution Sources”) and WAC 173-460 (“Controls for New Sources of Toxic Air Pollutants”), an acceptable source impact analysis will be performed to determine the impact of adding the 200-UP-1 OU streams to the treatment facility. The analysis will assess the maximum incremental ambient air impact levels to ensure that the facility will not exceed WAC 173-460 small quantity emission rates at the stack or, if applicable, to ensure that the new source toxic air pollutant emission rates do not exceed WAC 173-460 acceptable source impact levels at the nearest site boundary.

5.2 Waste Management

Table 5-1 presents a summary of the projected waste streams and volumes expected during well drilling, development, year-to-year groundwater sampling, and general systems operations. The specific requirements for waste identification, characterization, segregation, packaging, labeling, storage, and inspections during operation of the well field and 200 West Groundwater Treatment Facility will be managed in accordance with the waste management plan for the 200-ZP-1 OU (included as Appendix B in the 200 West P&T O&M plan [DOE/RL-2009-124]), which will be amended to incorporate the appropriate 200-UP-1 OU remedy requirements.

Table 5-2 presents a summary of the known waste streams and estimated volumes to be produced as a result of adding the third treatment train to the 200 West Groundwater Treatment Facility, and by treating the increased waste load from 200-UP-1 OU groundwater. The table presents the incremental increase for a full third train and is not a total facility waste projection. These projections are based on actual operating information for the two operational trains currently in service, the projected scope of work for the 200-UP-1 OU (13 new extraction and injection wells, and 26 new monitoring wells), and the design estimates presented in the *200 West Area Groundwater Pump-and-Treat Remedial Design Report* (DOE/RL-2010-13).

5.3 Cultural/Ecological

Protection of cultural resources is addressed, in part, during the ARAR identification process based on CERCLA and the NCP (40 CFR 300) guidance. The lead and non-lead agencies identify requirements that are applicable or relevant and appropriate to the release or remedial action at a CERCLA site (NCP, 40 CFR 300.400[g]). The ARARs for the 200-UP-1 OU remedial action are provided in Appendix C of this RD/RA work plan.

Table 5-1. Summary of Waste Streams and Estimated Volumes from Well Drilling/Development and Annual Sampling for 200-UP-1 Wells

General Waste Stream Description	Hazard Classifications Anticipated	Container Options	Estimated Volumes	Disposal Pathway Options
Drill cuttings including dry soil, saturated slurries, and sample returns from 13 new extraction and injection wells, and 26 new monitoring wells	Mixed waste (environmentally controlled media/hazardous)	Roll-on/roll-off boxes and drums	Extraction/injection = 6,500 ft ³ Monitoring wells = 6,500 ft ³	ERDF
Liquids from the following: <ul style="list-style-type: none"> Well development (39 wells) Annual sampling/purging (119 wells [93 existing and 26 new]) Annual and semiannual preventative maintenance on extraction and injection wells 	Environmentally controlled media	Tank Purgewater trucks Temporary transfer drums Purgewater truck	1,950,000 gal (development) 95,200 gal/yr 215,000 gal/yr	2WTF Modular storage units
Miscellaneous solid waste including personal protective equipment, clothes, plastic, wipes, wood, equipment, tools, pumps, wire, metal casing, and plastic pipe for operating 16 extraction and injection wells and sampling 26 monitoring wells annually	Mixed waste (environmentally controlled media/hazardous)	4 ft by 4 ft by 8 ft wood boxes (128 ft ³ each) Drums and purgewater truck	Well drilling: 2,048 ft ³ Annual purging and sampling: 42 drums/yr from sampling	ERDF
Spent/excess chemicals/reagents and used oils (preventative maintenance on motors and equipment)	Hazardous dangerous, nonregulated	Drums	100 gal/yr	Offsite
Decommissioning of 16 extraction and injection wells and 2 transfer stations, including concrete rubble, wood, rebar, metal/plastic pipes and screens, wire, bentonite, sand, gravels, equipment, pumps, tanks, etc.	Nonregulated, (nondangerous, nonhazardous) for nongroundwater contact Mixed waste for groundwater contact	4 ft by 4 ft by 8 ft wood boxes	250 each	ERDF
General construction debris, office and lunch waste/paper trash	Nonregulated (nondangerous, nonhazardous)	Trash bags	10/day or 3,650/yr in 1-year construction schedule	Contractor-provided dumpster, municipal landfill

2WTF = 200 West Groundwater Treatment Facility

CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*

ERDF = *Environmental Restoration Disposal Facility*

RCRA = *Resource Conservation and Recovery Act of 1976*

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Table 5-2. 200 West Groundwater Treatment Facility Waste Streams and Estimated Volumes Associated with Adding the Third Treatment Train and Treating 200-UP-1 OU Groundwater

General Waste Stream Description	Hazard Classifications Anticipated	Container Options	Annual Increase in Volumes for Third Train	Disposal Pathway Options	Hazard Source
Dewatered and stabilized sludge	Mixed (radiological/hazardous)	Roll-on/roll-off boxes Drums	300 to 400 tons/yr	ERDF	CERCLA
Spent resins	Mixed (radiological/hazardous)	4 ft by 4 ft by 8 ft wood box	900 ft ³ /yr or 90 tons/yr	ERDF	CERCLA
Miscellaneous solid waste including filter paper, filter socks, wipes, personal protective equipment, cloth, plastic, wood, pumps, wire, metal and plastic piping, and air-stripper tower packing, materials from cleanup of unplanned release	Mixed (environmentally controlled media/hazardous)	4 ft x 4 ft by 8 ft wood box Drums	200 ft ³ or 1.23 tons	ERDF	CERCLA
Liquids from sample analysis and screening (4 L per well per year for 126 monitoring wells)	Mixed waste	Tank Drums	113 gal/yr	2WTF ETF Modular storage units	CERCLA
Spent/excess chemicals/reagents and used oils	Hazardous dangerous nonregulated	Drums	TBD	Offsite	RCRA
General construction debris, office/lunch waste	Nonregulated (nondangerous, nonhazardous)	Roll-on/roll-off boxes	TBD	Offsite (Basin Disposal Inc.)	CERCLA

2WTF = 200 West Groundwater Treatment Facility

CERCLA = *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*

ERDF = Environmental Restoration Disposal Facility

ETF = Effluent Treatment Facility

RCRA = *Resource Conservation and Recovery Act of 1976*

TBD = to be determined (based upon final design)

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Potential location-specific ARARs identified include those that protect ecological, cultural, historic, and Native American sites and artifacts (resources):

- *Migratory Bird Treaty Act of 1918.*
- The *Native American Graves Protection and Repatriation Act of 1990*, which requires federal agencies and institutions receiving federal funding to return Native American cultural items and human remains to their respective peoples. It also authorizes a program of federal grants to assist in the repatriation process.
- *Archaeological Resources Protection Act of 1979*, which provides for the protection of archaeological resources on federal and Native American lands, prohibits the defacement or destruction of archaeological sites and; prohibits the sale/purchase of archaeological artifacts.
- *Archaeological and Historic Preservation Act of 1974.*
- *National Historic Preservation Act of 1966* (Sections 106 and 110), and 36 CFR 800 (“Protection of Historic Properties”), which mandate federal agencies to (1) go through a review process for all federally funded and permitted projects that will impact sites listed on or eligible for the National Register of Historic Places, and (2) take into account the effect a project may have on historic properties and allow opportunity for interested parties to comment on the potential impacts.
- *American Indian Religious Freedom Act* and Executive Order 13007 (*Indian Sacred Sites*), which provide protection and preservation of traditional religions of Native Americans.

These federal acts mandate the identification and protection of ecological and archeological objects and historical data, including human remains, funerary objects, sacred objects, and objects of cultural significance. Prior to disturbing the earth (e.g., drilling, surface grubbing, and excavating), RL will initiate discussion with the affected parties (as prescribed by the *National Historic Preservation Act of 1966*), and an analysis of cultural and ecological resource impacts will be undertaken. This will include an assessment of the resources present and a qualitative comparison to the risk posed by the contaminants present in the OU.

Preservation of cultural and historical properties under the *National Historic Preservation Act of 1966* is considered in remedial action decisions under the Tri-Party Agreement (Ecology et al., 1989). A cultural resources review is part of work planning activities, and the project will involve cultural resources staff early in the planning stage to address potential concerns and consider the effects that the planned project activities could have.

5.4 Safety and Health Program

The remediation contractor’s hazardous waste health and safety program was developed for employees involved in hazardous waste site activities. The program was developed to comply with the requirements of 10 CFR 851, which incorporates the safety standards of 29 CFR 1910.120 (“Occupational Safety and Health Standards,” “Hazardous Waste Operations and Emergency Response”), and of 10 CFR 835 (“Occupational Radiation Protection”), to ensure the safety and health of workers during operations involving potential exposure to hazardous and radioactive materials.

The *Soil and Groundwater Remediation Project Site-Specific Health and Safety Plan (HASP)* (SGW-41472, Rev. 8, dated April 2012) was developed in accordance with the overall remediation contractor’s health and safety program to define the chemical, radiological, and physical hazards and to specify the controls and requirements for day to day work activities on the overall Hanford Site. It also

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incorporates applicable core functions and guiding principles outlined in the Integrated Safety Management System, and governs minimal personal training, control of industrial safety and radiological hazards, personal protective equipment, site control, and general emergency response to spills, fire, accidents, injury, and incident reporting.

The current 200 West P&T project applies the approved S&GRP HASP that governs routine operations of the treatment facility and related 200-ZP-1 OU well field extraction, injection, and conveyance systems. However, HASPs are not stand-alone documents; they are supplemented by other procedures governing work control, conduct of operations, industrial safety, maintenance, and waste handling. An industrial hygiene exposure assessment, which serves as the baseline hazards analysis, has been completed and is followed for current facility operations.

The HASP (with related procedures and work instructions) governs safe performance of routine facility operations and maintenance activities, including facility inspection and surveillance, equipment replacement, maintenance, housekeeping, and sampling. It also governs personnel safety training requirements; control of recognized health and safety hazards; use of personal protective equipment; facility access requirements; and contingencies such as fire, spills, accidents, personnel injuries, and incident reporting.

Regarding construction of the work elements associated with the 200-UP-1 OU remedy (e.g., wells, piping and pipe racks, transfer buildings, etc.), the HASP will draw on the processes and procedures that were used to build the 200 West P&T in 2011 and 2012. Access and work activities will be controlled in accordance with the approved HASP and related work control packages, as required by established internal work requirements and processes. Work control packages, procedures, and work instructions further control site and task operations, which include activity-based hazard analyses (e.g., job safety/hazard analyses) and may also reference applicable radiological control requirements and industrial hygiene monitoring. Any entry into planned excavation sites will require an additional planning activity. Any subcontractor used for portions of the work will also have safety submittal documents that become an integral part of the site safety expectations. The construction contractor's HASP and ongoing job safety/hazard analyses will address the health and safety hazards during each phase of construction project. The long-term operations of the treatment facility will be covered by the existing HASP (SGW-41472, Rev. 8) and related job safety/hazard analyses.

Project field staff will be required to comply with all aspects of HASPs, work packages, work instructions, and procedures at all times during construction and operation of the equipment. Unescorted site visitors will be required to read and sign the HASP before entering the construction area and must have completed required training. Escorted visitors will be briefed on health and safety aspects of the work being observed and will be escorted by the site superintendent (or designee) at all times when they are in the construction area.

5.5 Emergency Response

During construction and operations, emergency response for project activities will be covered by the project-specific HASP, and related health and safety procedures and work instructions. The HASP, health and safety procedures, and work instructions contain primary emergency response actions for site personnel, area alarms, implementation of the emergency action plan, and emergency equipment at each task site, as well as the emergency coordinators, emergency response procedures, and spill containment. A copy of the HASP will be kept in the construction field office and in the 200 West Groundwater Treatment Facility control room.

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When emergencies arise that are beyond the limitations of the project-specific HASP, *Emergency Plan Implementing Procedures* (DOE-0223) will govern project staff response, as specified in the HASP.

5.6 Quality Assurance Program

Overall QA for the RD/RA work plan will be planned and implemented in accordance with 10 CFR 830, Subpart A (“Nuclear Safety Management,” “Quality Assurance Requirements”); *EPA Requirements for Quality Assurance Project Plans*, EPA QA/R-5 (EPA/240/B-01/003); and *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, Third Edition; Final Update IV-B* (SW-846). The QA activities will use a graded approach based on the potential impact to the environment, safety, health, reliability, and continuity of operations. QA for routine operations-based sampling (as well as compliance and performance monitoring) will be discussed in the O&M plan, PMP, or associated SAPs and will comply with the following requirements:

- DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Documents*
- DOE O 414.1D, *Quality Assurance*

All SAPs prepared to support the 200-UP-1 OU remedial action will contain a QA project plan, which establishes the quality requirements for environmental data collection, including planning, implementation, and assessment of sampling, field measurements, and laboratory analysis.

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6 Decontamination and Decommissioning

The decontamination and decommissioning (D&D) of the 200-UP-1 OU P&T system will be addressed after RL and EPA determine that the treatment system is no longer required to support the implementation of the remedial action. The D&D of the system will be performed in accordance with the CERCLA process.

The existing WMA S-SX extraction system implemented under the previous interim ROD (EPA/ROD/R10-97/048) and RD/RA work plan (DOE/RL-97-36) will not require D&D activities at this time. This system is incorporated in its entirety into this work plan and operations will continue, as is, under this plan.

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7 Cost and Schedule

7.1 Cost Estimate

Table 7-1 provides the cost estimate for the 200-UP-1 OU remedy for the 5-year period from fiscal year (FY) 2013 through FY 2017. This time frame includes the planning, design, and construction of the P&T system; initial P&T operations; and remedy performance monitoring and reporting. The cost estimate for the remedial action will be included in the RDR based on the 90% design. The cost estimate in the RDR will also be compared to the original estimate in the 200-UP-1 OU ROD Schedule.

Figure 7-1 provides the project schedule through FY 2018, at which time all of the 200-UP-1 OU P&T components should be designed and constructed. The schedule for the remedial action may be updated after initial remedial design is completed as part of the RDR.

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Table 7-1. 200-UP-1 OU Remedy Implementation Cost Summary

Activity	FY13	FY14	FY15	FY16	FY17	FY18	Total (\$)
Planning/Design							
Remedial Design/Remedial Action Work Plan	\$325,000	-	-	-	-	-	\$325,000
Remedial Design	-	\$2,743,000	\$994,000	-	-	-	\$3,737,000
Remedial Design Report	-	\$20,000	\$103,000	-	-	-	\$123,000
Performance Monitoring Plan	-	\$75,000	\$417,000	-	-	-	\$492,000
Operations and Maintenance Plan	-	-	-	\$440,000	-	-	\$440,000
I-129 Technology Evaluation Plan	-	-	-	\$880,000	-	-	\$880,000
U Plant Area Plume							
U Plant Plume Area Construction (includes U & Tc-99 IX trains, I/E wells)	-	-	-	\$21,912,000	\$7,304,000	-	\$29,216,000
U Plant Plume Area O&M	-	-	-	-	\$840,000	\$533,000	\$1,373,000
I-129 Plume							
I-129 Plume Area Construction (includes I wells)	-	-	-	\$3,908,000	\$1,303,000	-	\$5,211,000
I-129 Plume Area O&M	-	-	-	-	\$320,000	\$349,000	\$669,000
SE Chromium Plume							
SE Chromium Plume Area Design/Construction (includes I/E wells)	-	-	-	-	\$1,282,000	\$16,135,000	\$17,417,000
WMA S/SX Area Plume							
WMA S/SX Plume Area O&M	\$97,000	\$189,000	\$189,000	\$189,000	\$189,000	\$189,000	\$1,042,000
Remedy Performance Monitoring							
Monitoring Well Installations (26)	-	-	-	\$12,481,000	\$5,433,000	-	\$17,914,000
Monitoring Well O&M (56 wells)	-	-	-	\$1,174,000	\$1,174,000	\$1,174,000	\$3,522,000
Remedy Performance Monitoring/Reporting	\$83,000	\$96,000	\$96,000	\$1,769,000	\$1,769,000	\$1,769,000	\$5,582,000
Project Management							
Project Management	\$126,000	\$759,000	\$759,000	\$759,000	\$759,000	\$759,000	\$3,921,000
Institutional Controls							
Institutional Controls	\$246,000	\$246,000	\$246,000	\$246,000	\$246,000	\$246,000	\$1,476,000
Totals	\$877,000	\$4,128,000	\$2,804,000	\$43,758,000	\$20,619,000	\$21,154,000	\$93,340,000

FY = fiscal year
E/I wells = extraction/injection wells
IX = on exchange
O&M = operation and maintenance
WMA = waste management area

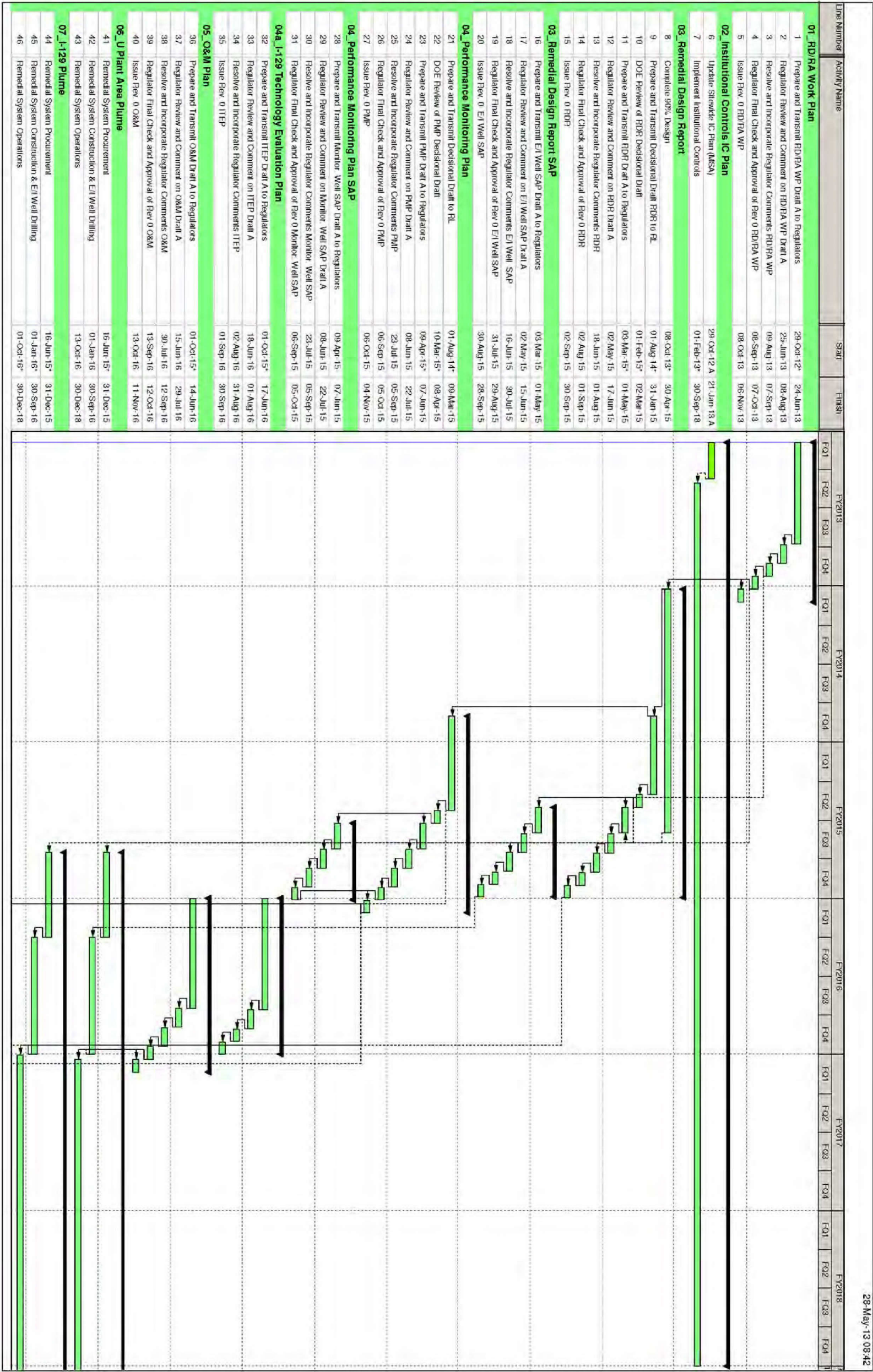


Figure 7-1. 200-UP-1 OU Remedy Implementation Schedule

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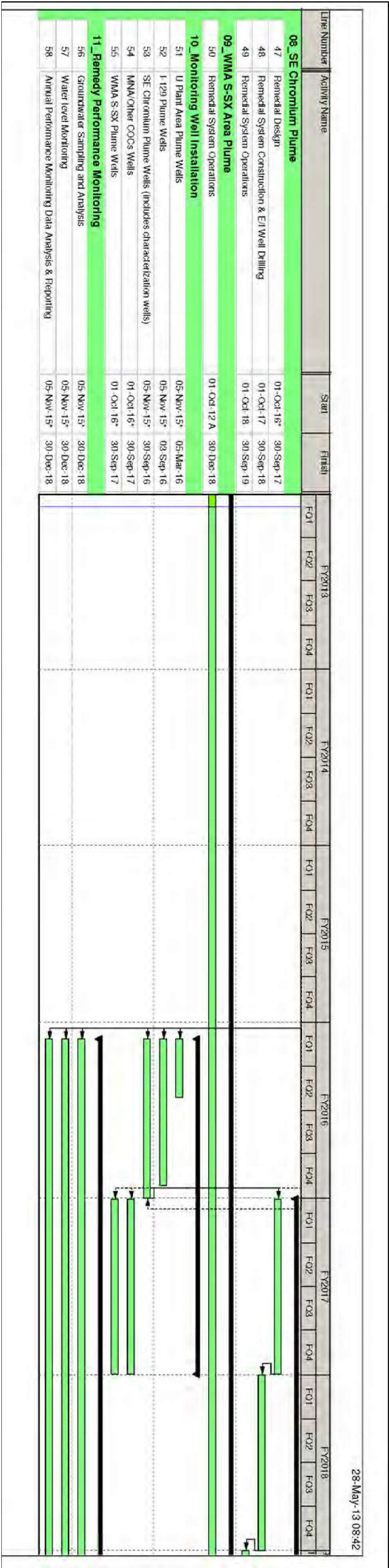


Figure 7-1. 200-UP-1 OU Remedy Implementation Schedule (con't)

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Appendix A

Nature and Extent of 200-UP-1 Operable Unit Groundwater Contamination

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Terms

1		
2	CERCLA	<i>Comprehensive Environmental Response, Compensation, and Liability Act of 1980</i>
3	COC	contaminant of concern
4	CY	calendar year
5	DWS	drinking water standard
6	HSU	hydrostratigraphic unit
7	OU	operable unit
8	RCRA	<i>Resource Conservation and Recovery Act of 1976</i>
9	WMA	waste management area
10		

A1 200-UP-1 Groundwater Contamination Nature and Extent

This appendix provides a summary of the current distribution of contaminants of concern (COCs) in the 200-UP-1 Operable Unit (OU) unconfined aquifer illustrated in contaminant conceptual cross sections. The current spatial extent of contamination beneath the 200-UP-1 OU, including contaminants sourced from the adjoining 200-ZP-1 OU, is illustrated in Figures A-1 and A-2. Figures A-1 and A-2 illustrate regional and supplemental detail maps showing well locations and the orientation of contaminant conceptual cross sections used to illustrate the current nature and extent of the COC plumes beneath the 200-UP-1 OU, respectively. These cross sections provide updates to the previous contaminant conceptual cross sections presented in the *Remedial Investigation/Feasibility Study for the 200-UP-1 Groundwater Operable Unit* (DOE/RL-2009-122). The cross sections illustrate the current vertical and lateral extent of the contaminants based on available depth-discrete groundwater data. The vertical extent of the plumes illustrated on the cross sections will appear unusually long compared to the horizontal extent of the plumes because of the vertical exaggeration required to illustrate the aquifer detail. The cross sections are consistent with the calendar year (CY) 2011 groundwater plume maps (Figures A-1 and A-2) and the current CY 2011 water table map (DOE/RL-2011-118, *Hanford Site Groundwater Monitoring for 2011*). The data used for this interpretation consist of the results of depth-discrete and routine groundwater sampling conducted to support the remedial investigation (DOE/RL-92-76, Rev. 1, *Remedial Investigation/Feasibility Study Work Plan for the 200-UP-1 Groundwater Operable Unit*), more recent sampling conducted under the *Resource Conservation and Recovery Act of 1976* (RCRA), and *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA).

A1.1 Technetium-99

Technetium-99 groundwater contamination is limited in extent to the three main source areas within the 200-UP-1 OU, namely Waste Management Area (WMA) U, the U Plant cribs, and the WMA S-SX single-shell tank farms. Within these areas, only WMA U and WMA S-SX remain active as treatment, storage, and disposal facilities. Figures A-1, A-2, A-3, and A-4 illustrate the current vertical and lateral extent of technetium-99 plumes, as defined by the 900 pCi/L drinking water standard (DWS) contour, sourced from (1) the 216-U-1/U-2 Cribs, and (2) WMA S-SX. Figure A-3 illustrates the current longitudinal (axial) extent of the southern and larger of the two WMA S-SX technetium-99 plumes. Figure A-4 illustrates the current longitudinal (axial) extent of the 216-U-1/U-2 Cribs plume along with the lateral (perpendicular) extent of both WMA S-SX plumes. Two separate WMA S-SX technetium-99 plumes are illustrated on the south end of Figure A-4. New depth-discrete groundwater results provide improved vertical and lateral plume delineation and illustrate the current mapped extent of the two plumes. The plumes are well defined and present only in the upper portion of the unconfined aquifer, as illustrated on the section (Figure A-4). This is consistent with the previous interpretation and determination of the local sources for both of these plumes.

The southern of the two WM S-SX technetium-99 plumes has the largest groundwater extent (Figure A-2) and is further defined on Figure A-3, which illustrates the updated extent of technetium-99 along the longitudinal axis of the plume. One new depth-discrete groundwater monitoring well, 299-W22-92, has been added to this section (Figure A-3) and provides an improved downgradient understanding of the vertical distribution of technetium-99 in the plume. The new data do not change the overall mapped extent of the plume but do indicate that the highest mass of technetium-99 groundwater contamination is moving further downgradient from the source.

A1.2 Uranium

Uranium groundwater contamination is limited in extent to the areas downgradient of the U Plant cribs (primarily the 216-U-1/U-2 Cribs) and a small area downgradient near the U Pond and 216-S-21 Crib. Figures A-2 and A-5 illustrate the current vertical and lateral extent of the uranium plume sourced from the 216-U-1/U-2 Cribs. This conceptual cross section (Figure A-5) illustrates the current longitudinal (axial) extent of the 216-U-1/U-2 Cribs plume, defined by the 30 µg/L DWS contour.

Uranium concentrations for all wells within the defined plume section have decreased slightly since 2009. The extent of the uranium plume remains localized downgradient of the 216-U-1/U-2 Cribs; only the upper quarter of the unconfined aquifer is contaminated with uranium above the DWS.

A1.3 Iodine-129

Iodine-129 groundwater contamination is widespread within the 200-UP-1 OU and is sourced from multiple S Plant and U Plant cribs. The separate area plumes merge downgradient, forming a much larger comingled plume area that extends across the OU and is generally following the same groundwater flow path across the OU as tritium (Figure A-1). Figures A-1 and A-6 illustrate the current vertical and lateral extent of the iodine-129 plume sourced from the 216-U-1/U-2 Cribs. The iodine-129 conceptual cross section, defined by the 1 pCi/L DWS contour (Figure A-6), illustrates the current longitudinal (axial) extent of the 216-U-1/U-2 Cribs plume.

The iodine-129 plume (Figure A-6) is significantly smaller in spatial extent compared to the 2009 interpretation (DOE/RL-2009-122). Changes in the groundwater iodine-129 plume extent at the water table are primarily due to improvements in the 2011 plume interpolation method, which is different than previous contouring methods (DOE/RL-2011-118).

Iodine-129 concentrations for all wells within the defined plume section have decreased slightly since 2009, except one well within the downgradient plume (299-W19-48), which increased slightly. The extent of the iodine-129 plume remains localized downgradient of the 216-U-1/U-2 Cribs; depth-discrete data define the mapped vertical extent of iodine-129 contamination (above the DWS) within the upper portion of the unconfined aquifer.

Figure A-7 illustrates the iodine-129 extent longitudinally beginning upgradient of the S Plant sources and ending downgradient near the eastern boundary of the 200-UP-1 OU. This figure illustrates two separate plumes: (1) the small emerging plume beneath the WMA S-SX (which is coincident with the WMA technetium-99 (Figure A-3), nitrate, and chromium plumes from that source); and (2) the much larger iodine-129 plume that forms from multiple smaller plumes merging downgradient from the 216-S-1/S-2, 216-S-7, and 216-S-9 Crib sources. The large merged plume area is interpreted to be contaminated above the 1 pCi/L DWS throughout the entire thickness of the unconfined aquifer down to the Ringold lower mud unit (hydrostratigraphic unit [HSU] 8). This is a conservative interpretation because there are no depth-discrete data available in this area to validate the vertical extent of the iodine-129.

A1.4 Nitrate

Nitrate groundwater contamination is widespread within the 200-UP-1 OU and is sourced from multiple S Plant and U Plant cribs. The separate area plumes merge downgradient, forming a much larger comingled plume area that extends across the OU and into the eastern downgradient 200-PO-1 OU. Figures A-1 and A-8 illustrate the current vertical and horizontal (longitudinal) extent of the nitrate plume, defined by the 45 mg/L DWS contour, sourced from the 216-U-1/U-2 Cribs. The nitrate plume

sourced from the 216-U-1/U-2 Cribs merges downgradient into the much larger nitrate plume from several different past-practice waste sites located south of the 216-U-1/U-2 Cribs.

Downgradient of the 216-U-1/U-2 Cribs, the entire vertical extent of the unconfined aquifer is interpreted to be contaminated with nitrate above the DWS, as confirmed by deep monitoring well 699-38-70C, located downgradient from the past sources (Figure A-8).

The nitrate plumes, sourced from the past-practice 216-S-25 Crib and originating upgradient of WMA S-SX, and from WMA S-SX, merge and overlap with the two WMA S-SX technetium-99 plumes (Figures A-2 and A-9). These plumes are much smaller in extent compared to the U Plant plumes, as can be seen by comparing the separate plumes depicted on Figure A-9. Depth-discrete data from new wells 299-W22-90, 299-W22-91, and 299-W22-92 show that the nitrate plumes downgradient of the WMA S-SX (above the DWS) have the same limited vertical distribution as the technetium-99 plumes and validates the interpretation of relatively local sources (Figure A-9).

A1.5 Chromium

Chromium groundwater contamination (total and hexavalent) is present as localized plumes near WMA S-SX, and also as a wider dispersed plume originating from past S Plant waste sites that extend downgradient beyond the 200-UP-1 OU boundary. Figures A-1, A-2, A-10, A-11, and A-12 illustrate the current vertical and lateral extent of the chromium plumes downgradient of WMA S-SX and the 216-S-20 Crib sources. The chromium conceptual cross sections, defined by the 48 µg/L DWS contour, illustrate the current longitudinal (axial) extent of the southernmost of two chromium plumes originating from WMA S-SX (Figure A-10), and the southeast chromium plume downgradient of the 216-S-20 Crib, which has resulted from past-practice releases from multiple sources that have merged downgradient into the southeastern plume (Figure A-11). Figure A-12 shows chromium contamination sourced from WMA S-SX and illustrates the extent of the two small, separate chromium plumes emanating downgradient from the tank farms.

The southeastern chromium plume extent was reduced in 2011 (Figure A-1) from previous interpretations as a result of several mapping changes, including use of a higher contaminant plume mapping cutoff concentration and improvements in the 2011 plume interpolation method (DOE/RL-2011-118). This southeastern chromium plume remains contaminated at levels above the DWS across the entire vertical extent of the unconfined aquifer downgradient of past-practice sources, as confirmed by deep monitoring well 699-30-66 and shallow monitoring well 699-32-62 (Figure A-11). Recent monitoring results from downgradient well 699-33-56 indicate that the plume has migrated beyond the OU boundary, into the adjacent downgradient 200-PO-1 OU (Figures A-1 and A-11). However, defining the full extent and plume configuration is limited to just a few wells, which results in a large degree of uncertainty and a more conservative interpretation. Data from future “no action” modeled results for these two monitoring wells (699-30-66 and 699-32-62) indicate that the chromium plume concentration has peaked in this region and is predicted to continue to decline into the future (Figure A-13).

Figure A-12 highlights the two localized chromium plumes sourced at WMA S-SX that are coincident with the two WMA S-SX technetium-99 and nitrate plumes (Figures A-2, A-4, and A-9). Depth-discrete data from new wells 299-W22-90, 299-W22-91, and 299-W22-92 show that the two chromium plumes (levels above the DWS) have similar vertical distributions downgradient of WMA S-SX as the two technetium-99 and nitrate plumes, which support the interpretation of relatively local sources. In addition, the two highest measured chromium concentrations in the 200-UP-1 OU occur at (1) well 299-W23-19 (1,010 µg/L), which is near the source of the southern WMA S-SX technetium-99 plume; and (2) at well 299-W22-44 (547 µg/L), which is near the source of the northern WMA S-SX technetium-99 plume and indicates a continuing sustained contribution from the vadose zone beneath the WMA S-SX sources

(Figures A-10 and A-12). Based on the surrounding chromium data, the northern WMA S-SX chromium plume is smaller in extent and most likely a more recent release compared to the larger southern plume.

A1.6 Carbon Tetrachloride

Carbon tetrachloride has accumulated in groundwater from multiple past sources (Plutonium Finishing Plant facilities) located within the 200-ZP-1 OU, which adjoins the 200-UP-1 OU to the north.

The contaminant has been dispersing and is merging downgradient into the much larger regional plume (Figure A-1). Figure A-14 illustrates the current vertical and lateral extent of the carbon tetrachloride plume, defined by the 5 µg/L DWS contour, across the 200-UP-1 OU from upgradient (near the 216-S-10 Pond and Ditch) to downgradient at the northeastern boundary of the OU.

Carbon tetrachloride concentrations for wells located in the southwestern and upgradient portion of the plume have decreased slightly since 2009; concentrations have decreased at the water table and also at the bottom of the unconfined aquifer (monitored by well 299-W27-2). Wells monitoring the downgradient, highest concentration portion of the plume (Figure A-14) are located nearest to the 200-ZP-1 OU boundary (see also Figure A-1) and are increasing, with a dramatic increase occurring near the bottom of the unconfined aquifer as monitored by well 699-38-70B. The eastern portion of the carbon tetrachloride plume remains contaminated above the DWS across the entire vertical extent of the unconfined aquifer downgradient of the past sources, as confirmed by deep monitoring wells 699-38-70B and 699-38-70C (Figure A-14). Continuing characterization of the plume is occurring, as necessary, in support of the 200-ZP-1 OU carbon tetrachloride pump-and-treat system design and operation.

A1.7 Tritium

Tritium contamination is present as a localized plume sourced upgradient near WMA S-SX, which has merged downgradient into the much larger and more dispersed plume originating from past S Plant sources that now extend downgradient toward the 200-UP-1 OU boundary. Figures A-1 and A-15 illustrate the current extent of tritium groundwater contamination (above the 20,000 pCi/L DWS contour) in a longitudinal cross section extending from upgradient of WMA S-SX to the eastern downgradient boundary of the 200-UP-1 OU. The tritium contamination sourced upgradient of WMA S-SX follows a similar downgradient flow path beneath WMA S-SX as the smaller plumes emanating from WMA S-SX (i.e., technetium-99, chromium, and nitrate). The tritium becomes widely dispersed as it moves downgradient beyond WMA S-SX and merges into the larger plume. The large merged plume area is conservatively interpreted to be contaminated above the 20,000 pCi/L DWS throughout the entire vertical thickness of the unconfined aquifer down to the Ringold lower mud unit (HSU 8). No depth-discrete data are available in this portion of the groundwater plume; however, depth-discrete tritium data from nearby well 699-36-70A indicated tritium contamination existed above the DWS throughout the unconfined aquifer.

A2 References

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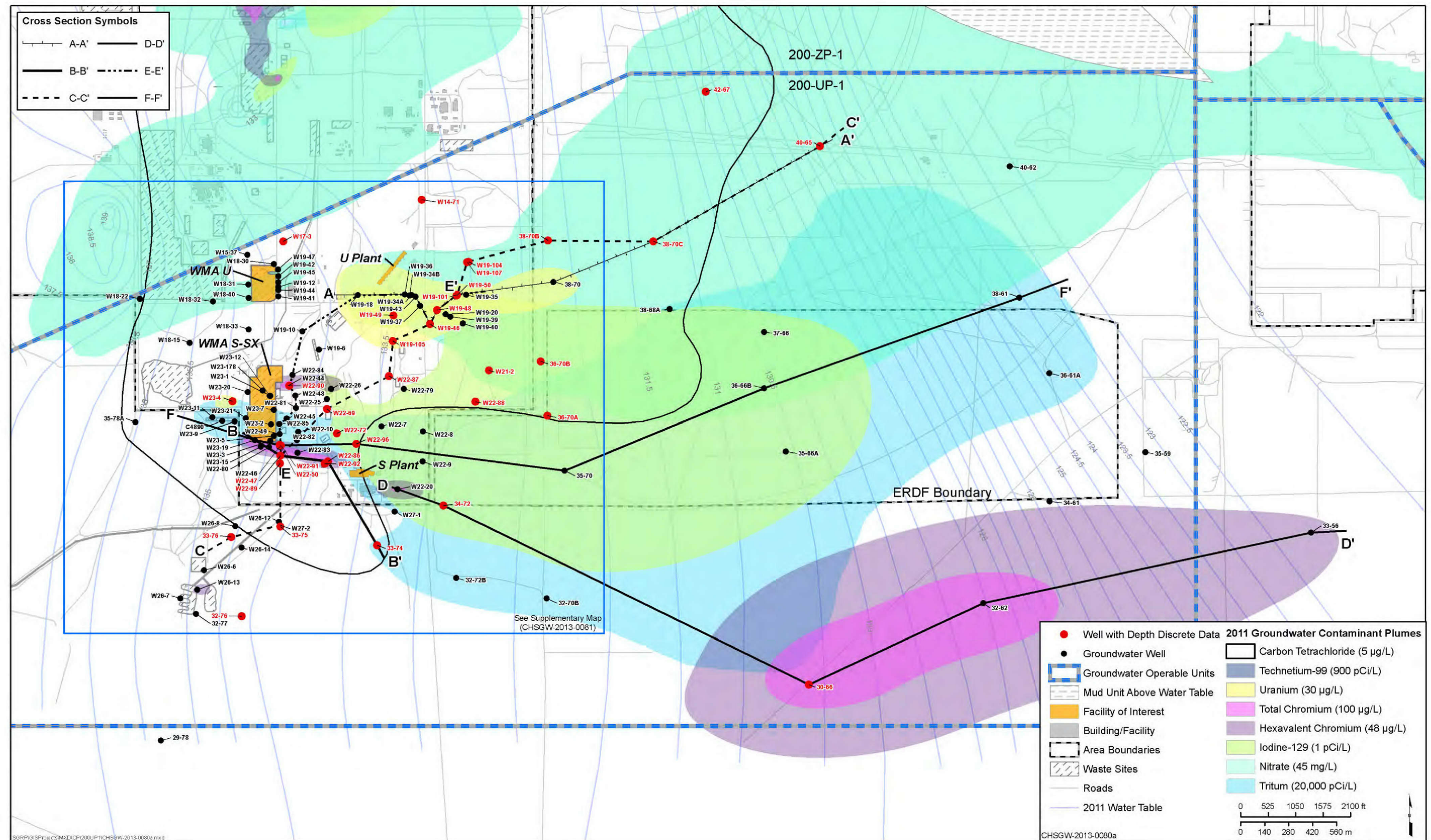
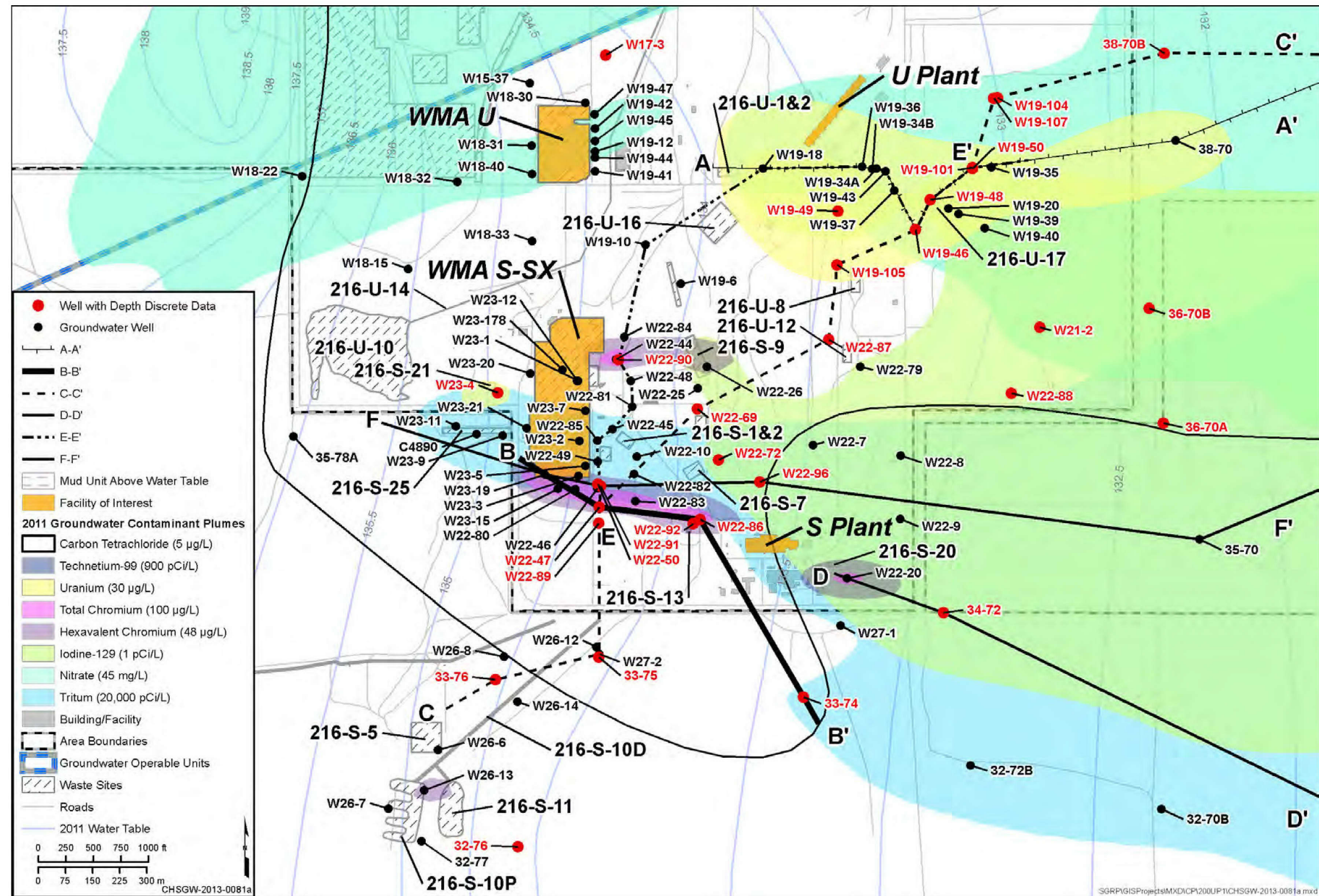


Figure A-1. Location Map Showing Groundwater Plumes and Conceptual Cross Section Orientations, 200-UP-1 OU



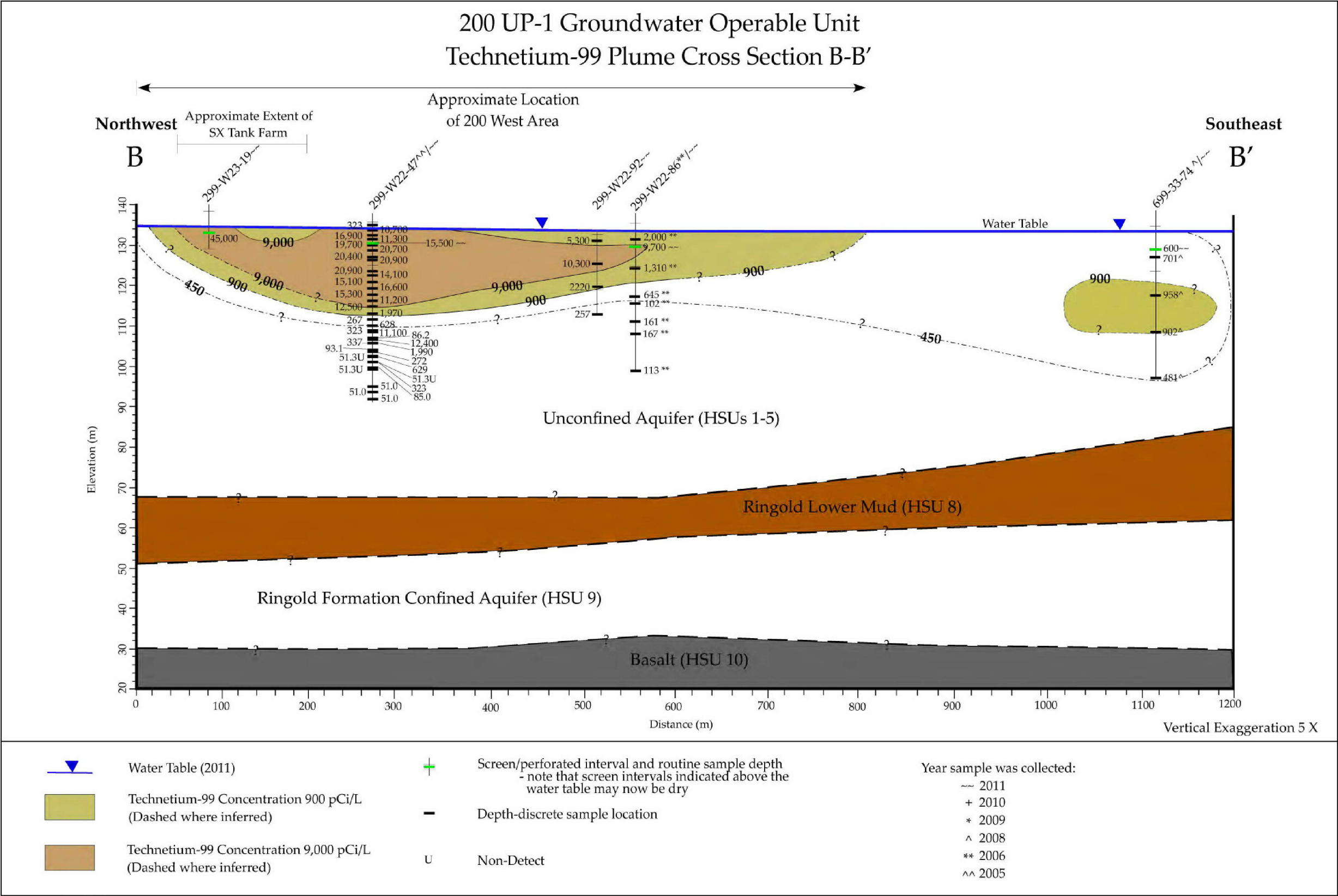


Figure A-3. Technetium-99 Conceptual Cross Section B-B'

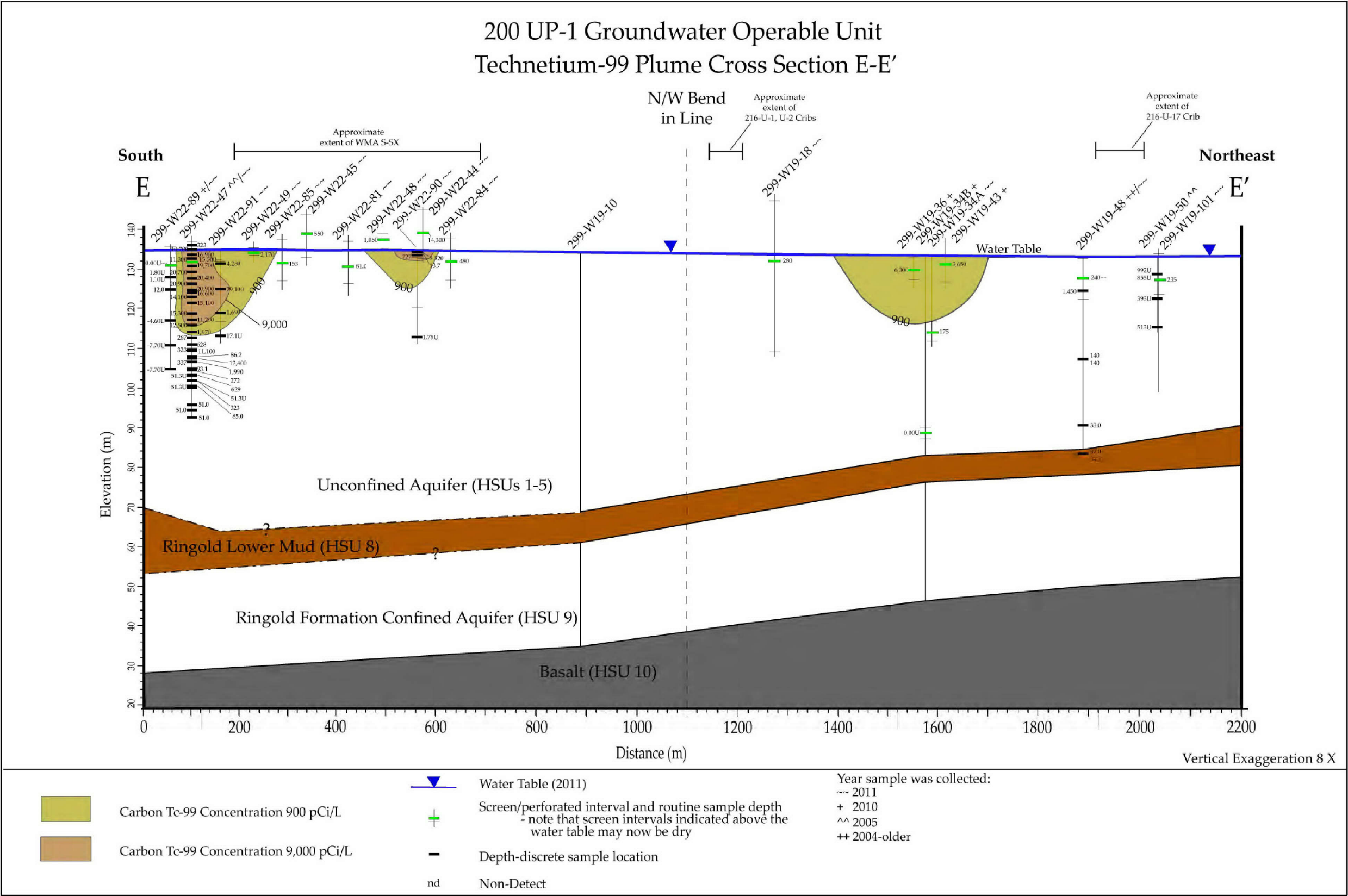
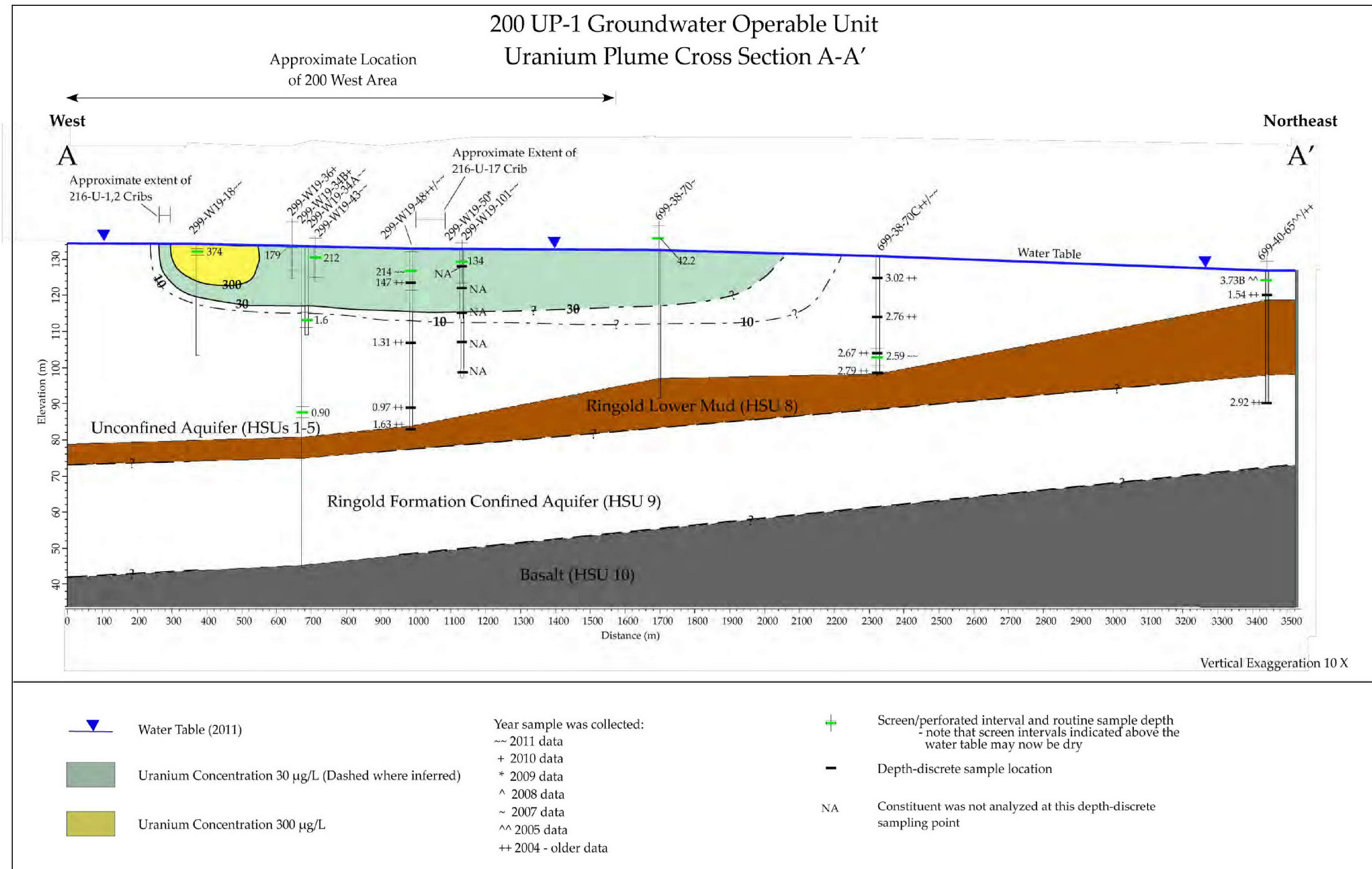


Figure A-4. Technetium-99 Conceptual Cross Section E-E'

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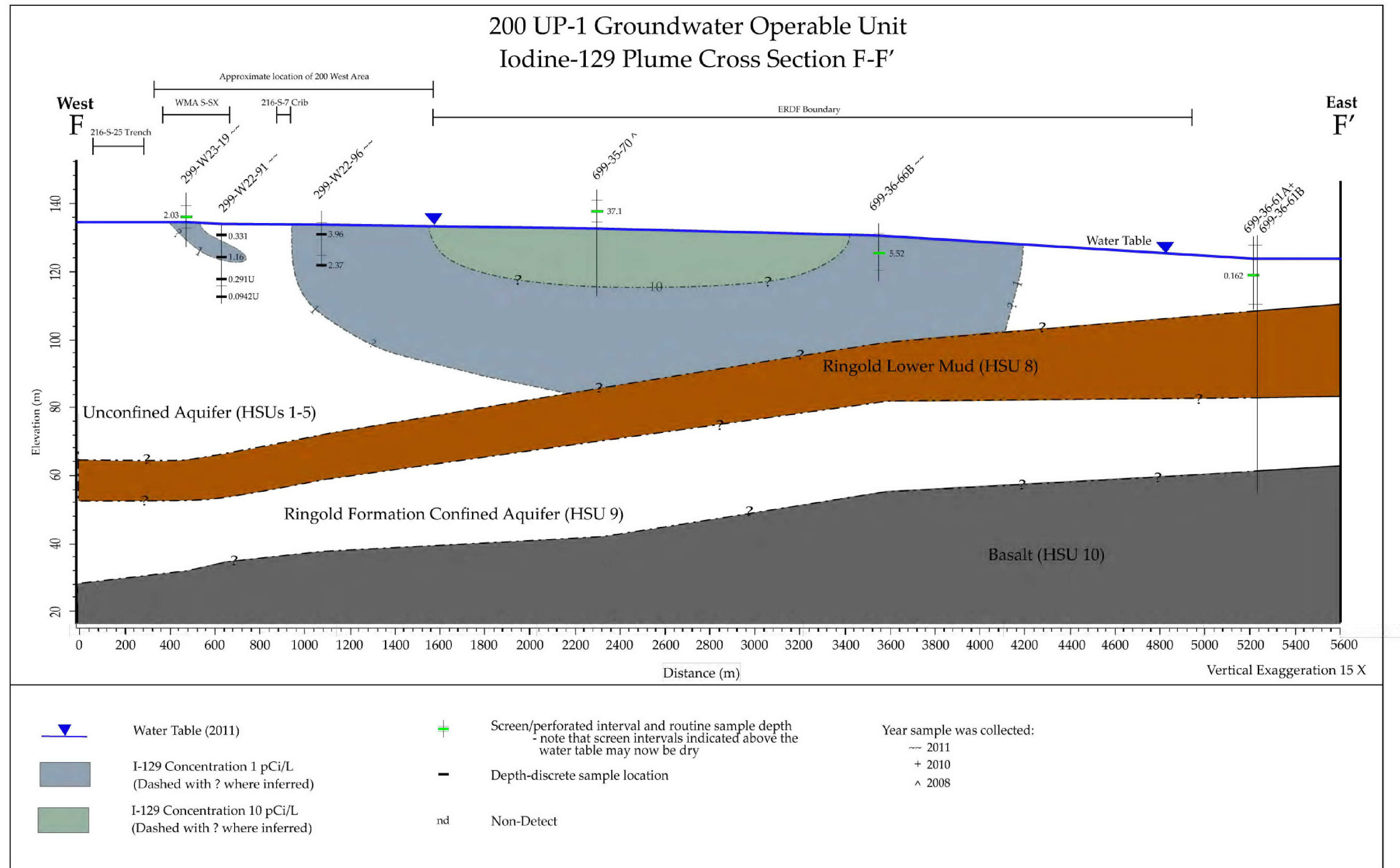


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Figure A-5. Uranium Conceptual Cross Section A-A'

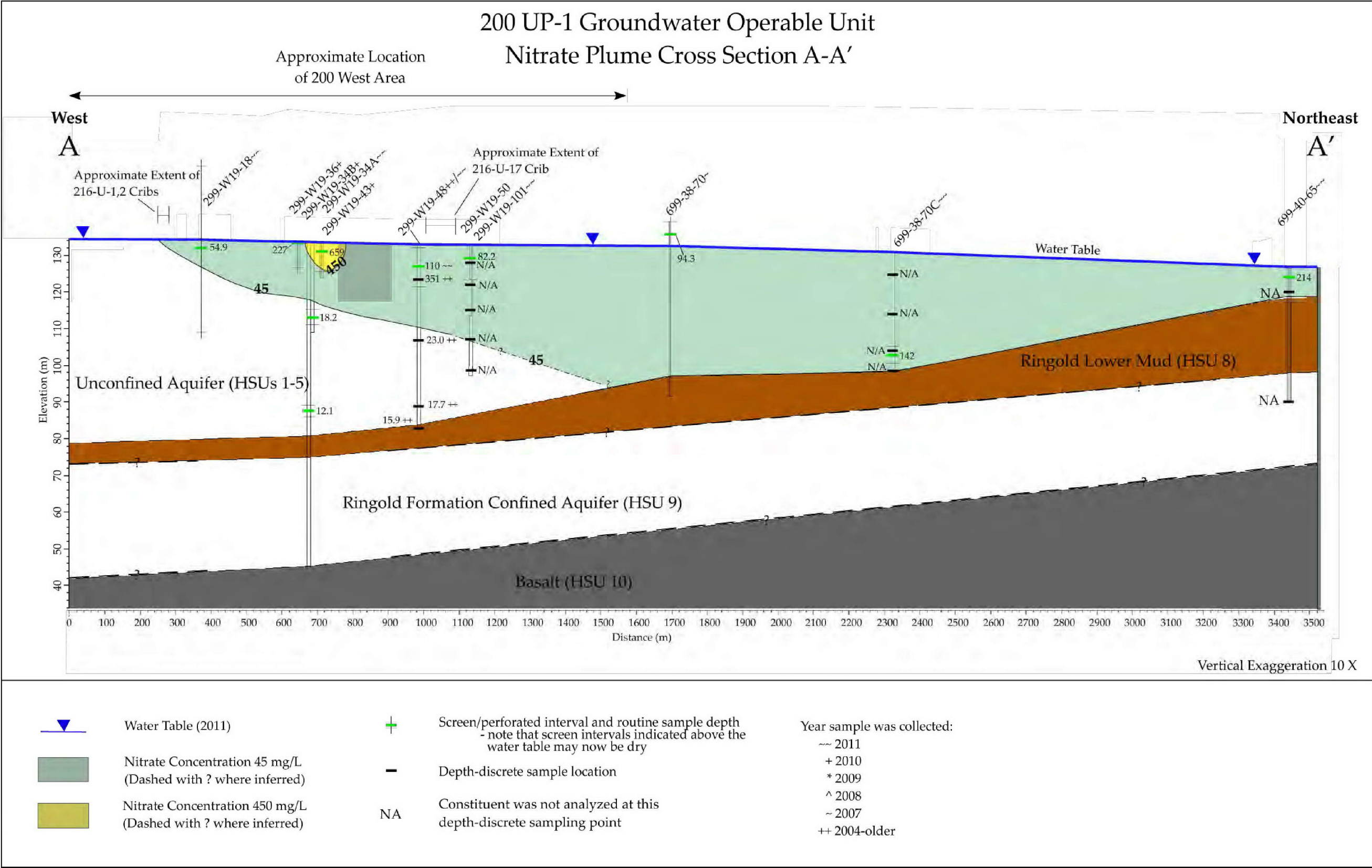


Figure A-6. Iodine-129 Conceptual Cross Section A-A'



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Figure A-7. Iodine-129 Conceptual Cross Section F-F'



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Figure A-8. Nitrate Conceptual Cross Section A-A'

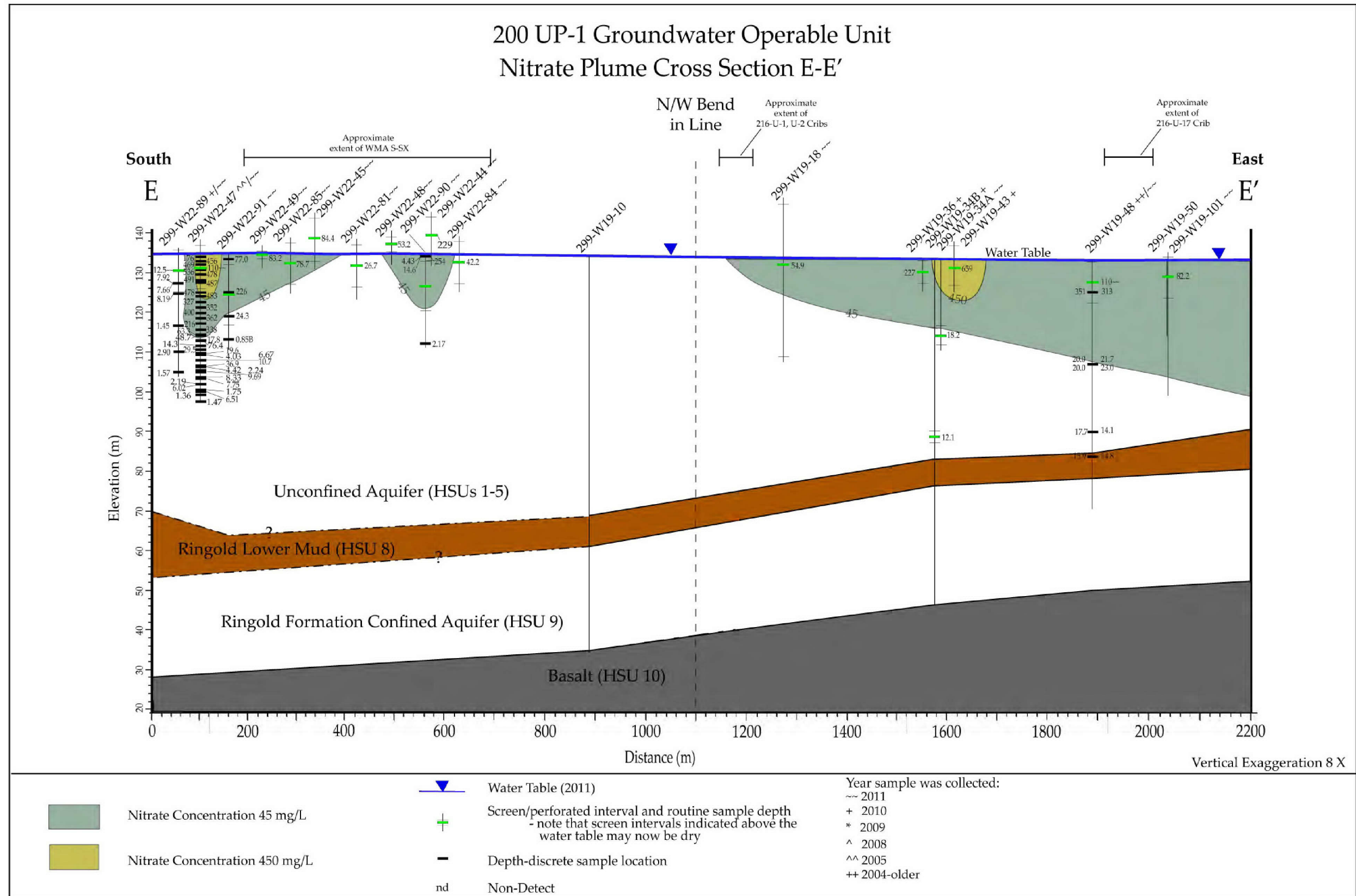


Figure A-9. Nitrate Conceptual Cross Section E-E'

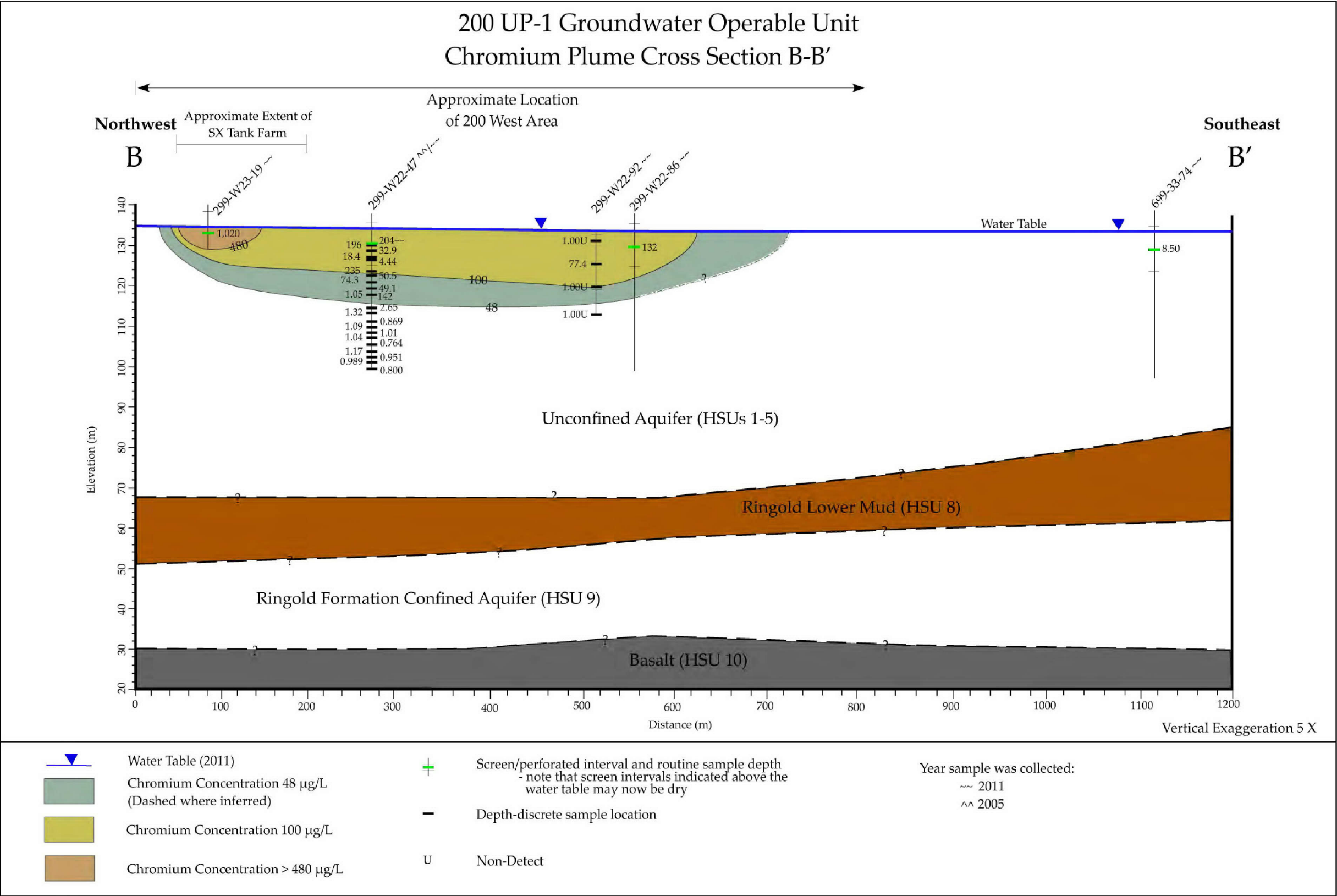


Figure A-10. Chromium Conceptual Cross Section B-B'

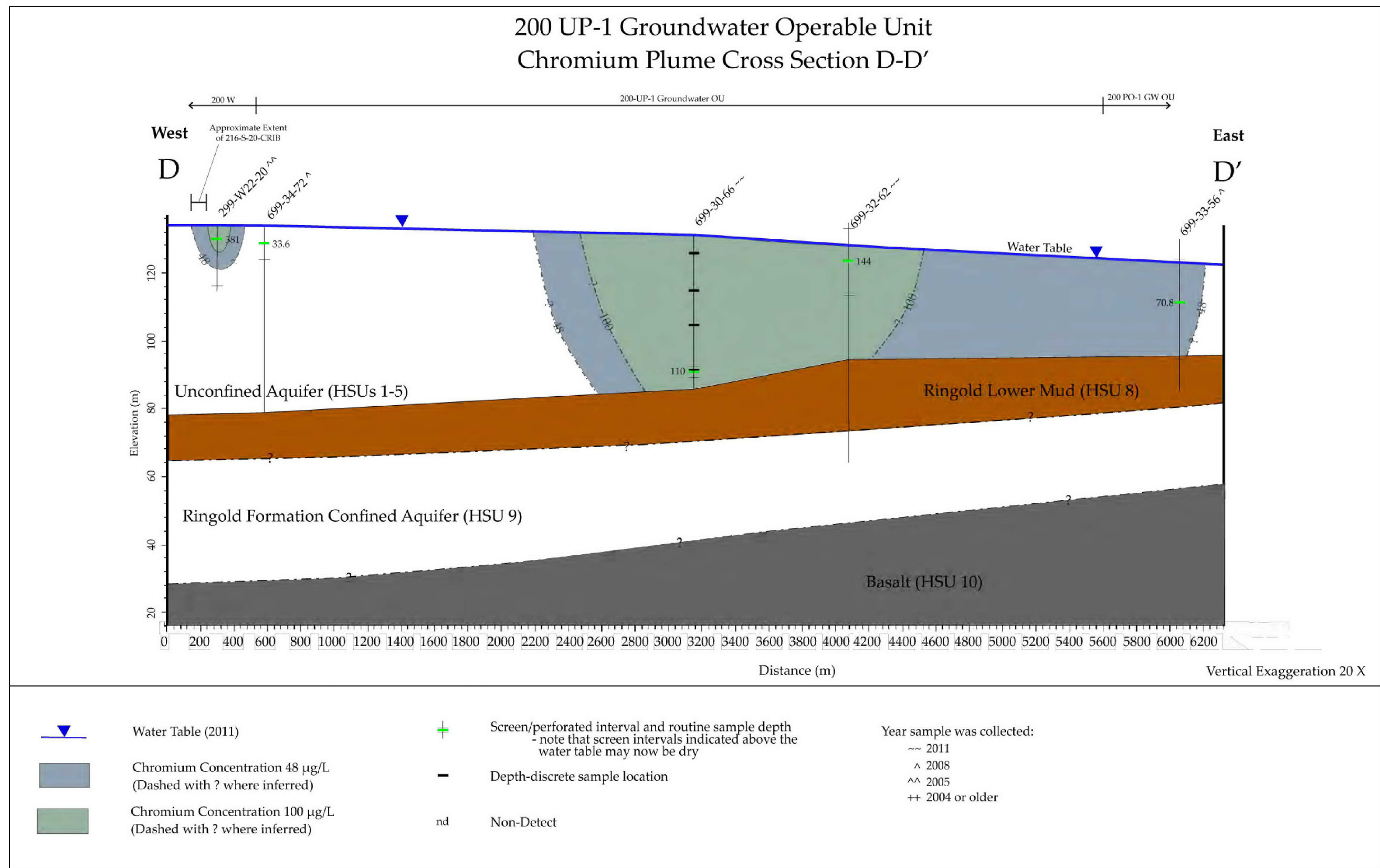


Figure A-11. Chromium Conceptual Cross Section D-D'

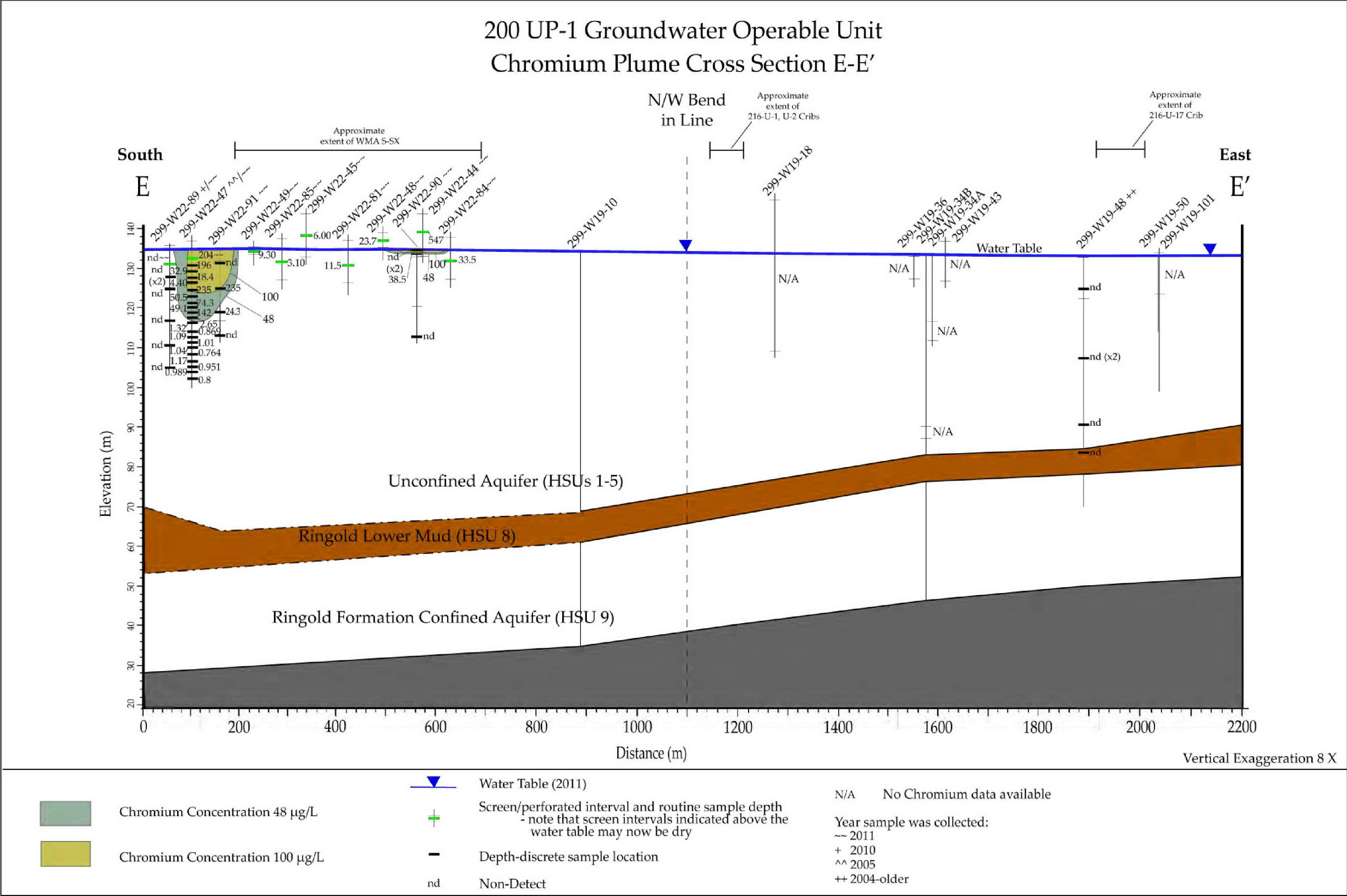


Figure A-12. Chromium Conceptual Cross Section E-E''

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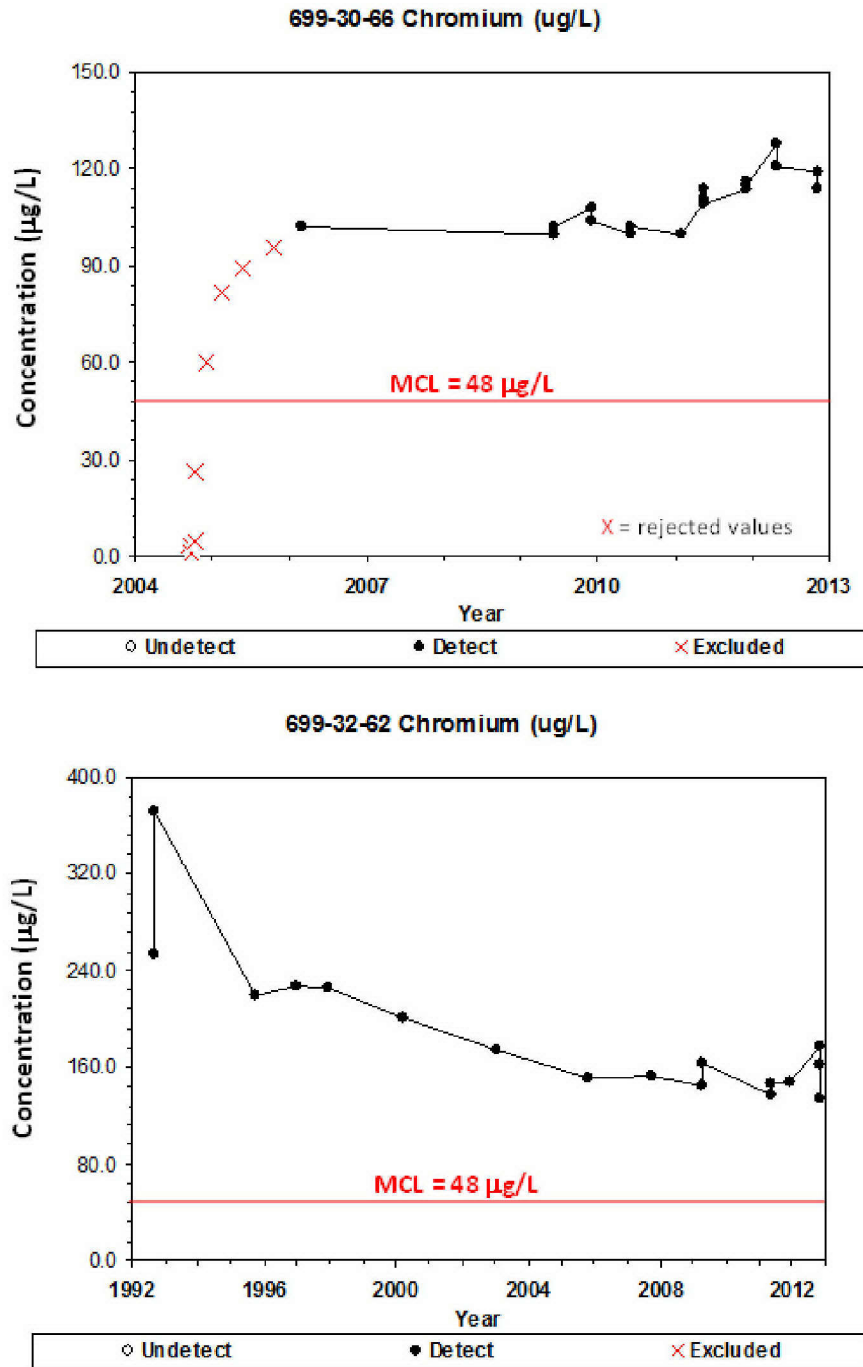


Figure A-13. Chromium Concentration Trends at Wells 699-30-66 and 699-32-62

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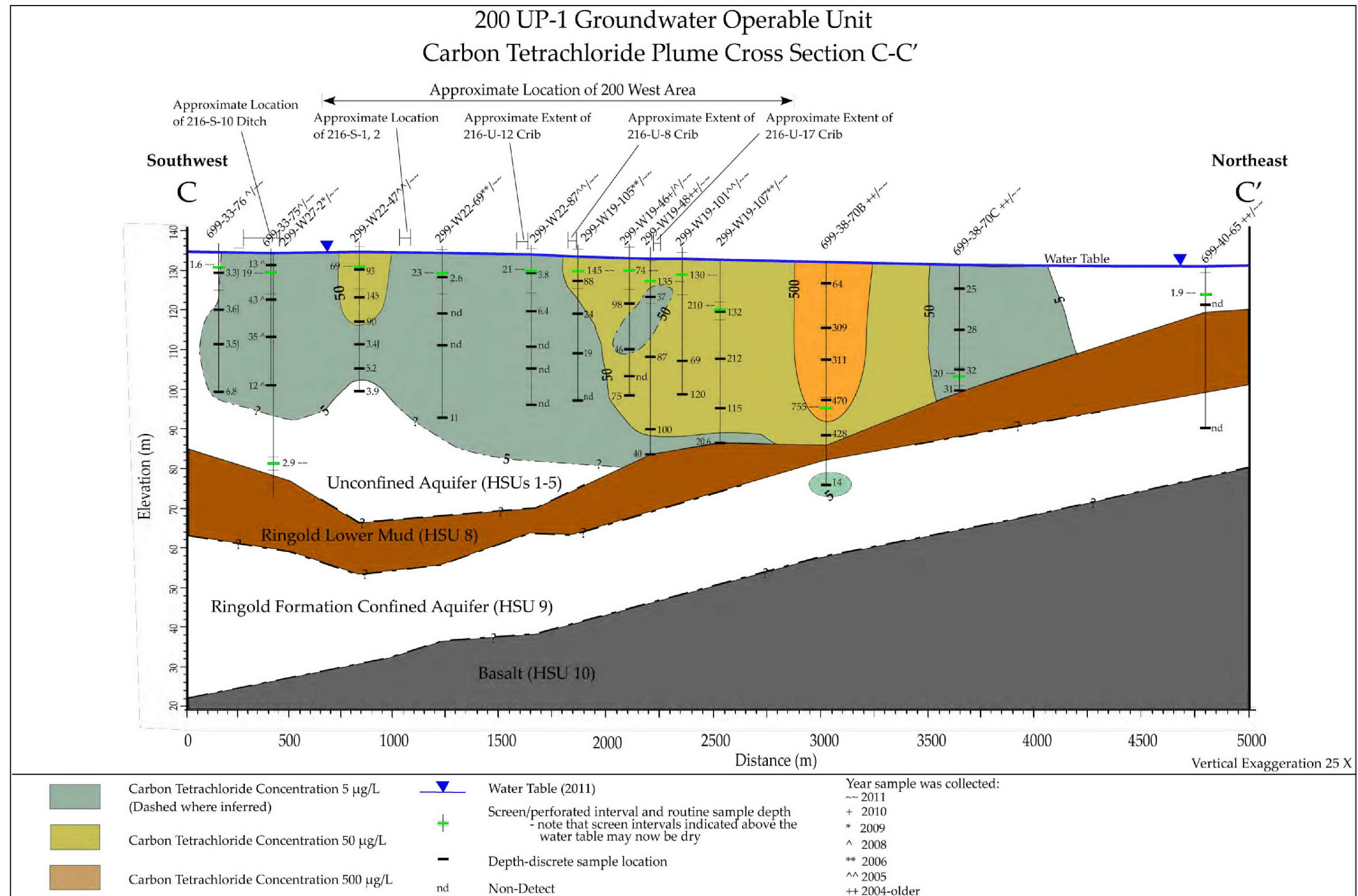


Figure A-14. Carbon Tetrachloride Conceptual Cross Section C-C'

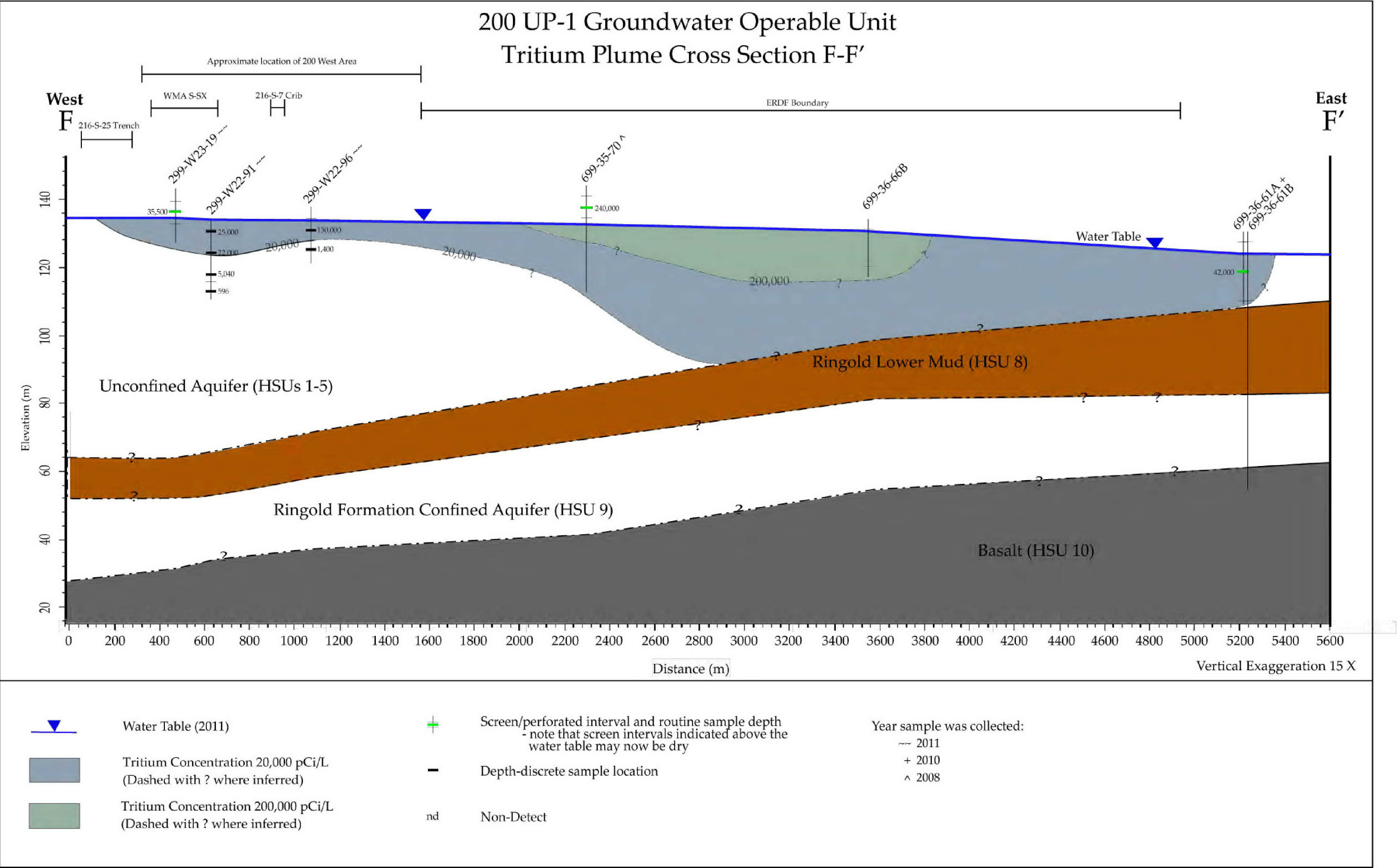


Figure A-15. Tritium Conceptual Cross Section F-F'

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Appendix B

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200-UP-1 Operable Unit Interim Groundwater Sampling Schedule

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B 200-UP-1 Operable Unit Interim Groundwater Sampling Schedule

Groundwater monitoring for the 200-UP-1 Operable Unit has been performed since 2005 in accordance with the sampling and analysis plan in the *Remedial Investigation/Feasibility Study Work Plan for the 200-UP-1 Groundwater Operable Unit* (DOE/RL-92-76, Rev. 1). The monitoring program was designed to provide information needed for the remedial investigation. However, the remedial investigation/feasibility study is now complete (DOE/RL-2009-122, *Remedial Investigation/Feasibility Study for the 200-UP-1 Groundwater Operable Unit*), so an interim monitoring program is needed until a performance monitoring plan is prepared and implemented. Table B-1 specifies the interim groundwater monitoring requirements for the 200-UP-1 Operable Unit. These requirements are based on the monitoring required by Tables A2-1, A3-1, and A3-2 in DOE/RL-92-76, Rev. 1, modified as follows:

- Dry wells have been removed.
- The frequency of sampling for many of the wells has been reduced.
- 1,4-Dioxane, carbon-14, and selenium-79 had been added as analytes for routine monitoring. These constituents were listed as additional contaminants of potential concern (COPCs) (Table A2-1 in DOE/RL-92-76, Rev. 1) for limited monitoring in selected wells (Table A3-2 in DOE/RL-92-76, Rev. 1). They were found to be present in groundwater at low concentrations and were subsequently added to the routine monitoring program per Section A3.2.3 of DOE/RL-92-76, Rev. 1. 1,4-Dioxane is retained for interim monitoring because it was identified as a COPC in the new Record of Decision (ROD) (*Record of Decision for Interim Remedial Action, Hanford 200 Area Superfund Site, 200-UP-1 Operable Unit* [EPA et al., 2012]). Carbon-14 is not a COPC in the new ROD so it is not retained. Selenium-79 is retained to meet the requirements of the *Atomic Energy Act of 1954*.
- Arsenic, cadmium, fluoride, iron, manganese, and methylene chloride were removed as required analytes because they were not retained as contaminants of concern or COPCs in the new ROD (EPA et al., 2012). Fluoride had been added to the monitoring program by the Washington State Department of Ecology in the remedial investigation/feasibility study work plan (DOE/RL-92-76, Rev. 1) approval letter.
- Well 299-W19-18 was added to provide additional information on uranium concentrations downgradient of the 216-U-1/2 Cribs.
- New monitoring wells 299-W22-95 (to be drilled) and 299-W22-96 (installed during 2011) were added.
- For the new wells installed during the remedial investigation, the temporary well names (e.g., UP-1) have been replaced with the final well names (e.g., 299-W19-107).
- Typographical errors were corrected (e.g., “new well M” had been listed as 299-W19-47, but it is actually 299-W19-49).
- Table A3-1 of DOE/RL-92-76, Rev. 1 specified well 299-W19-50 (new well L), but this well was abandoned during drilling. The replacement well is 299-W19-101.

The monitoring required in Table B-1 supersedes the monitoring required in Tables A2-1, A3-1, and A3-2 in DOE/RL-92-76, Rev. 1.

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- 1
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- 12 *Superfund Site, 200-UP-1 Operable Unit*, U.S. Environmental Protection Agency, Washington
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Table B-1. 200-UP-1 Operable Unit Interim Groundwater Sampling Schedule

Well Name ^a	Volatile Organic Analytes				Anions	Metals ^b	Radionuclides					
	Carbon Tetrachloride	Chloroform	1,4-Dioxane	Trichloroethene	Nitrate	Chromium (total)	Iodine-129	Selenium-79	Strontium-90	Technetium-99	Tritium	Uranium
299-W15-37	A	A	—	A	A	—	—	—	—	—	—	A
299-W18-15	A	A	—	A	A	—	—	—	—	—	—	A
299-W18-21	A	—	—	A	A	—	—	—	—	A	—	A
299-W18-22	A	—	—	A	A	—	—	—	—	A	—	A
299-W18-30	A	A	—	A	A	—	A	—	—	—	—	A
299-W19-101 (New Well L)	A	—	—	A	A	—	A	—	—	A	A	A
299-W19-105 (UP-2)	SA	—	—	—	SA	—	SA	—	—	SA	SA	SA
299-W19-107 (UP-1)	A	—	—	A	A	—	A	—	—	A	—	A
299-W19-18	A	—	—	—	A	—	A	—	—	A	—	A
299-W19-34A	A	A	—	A	A	—	A	—	—	A	—	A
299-W19-34B	BE	BE	—	BE	BE	—	BE	—	—	BE	—	BE
299-W19-35	SA	—	—	SA	SA	—	SA	—	—	SA	—	SA
299-W19-36	A	A	—	A	A	—	A	—	—	A	—	A
299-W19-39	SA	SA	—	SA	SA	—	SA	—	—	SA	—	SA
299-W19-4	BO	—	—	BO	BO	—	BO	—	—	BO	—	BO
299-W19-43	SA	SA	—	SA	SA	—	SA	—	—	SA	—	SA

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Table B-1. 200-UP-1 Operable Unit Interim Groundwater Sampling Schedule

Well Name ^a	Volatile Organic Analytes				Anions	Metals ^b	Radionuclides					
	Carbon Tetrachloride	Chloroform	1,4-Dioxane	Trichloroethene	Nitrate	Chromium (total)	Iodine-129	Selenium-79	Strontium-90	Technetium-99	Tritium	Uranium
299-W19-46 (New Well J)	SA	SA	—	SA	SA	—	SA	—	—	SA	SA	SA
299-W19-48 (New Well K)	SA	—	—	SA	SA	—	SA	—	—	SA	SA	SA
299-W19-49 (New Well M)	SA	—	—	—	SA	—	SA	—	—	SA	SA	SA
299-W21-2 (New Well Q)	A	—	—	—	A	—	A	—	A	A	A	A
299-W22-45	A	—	—	A	A	—	A	—	A	—	A	A
299-W22-49	SA	—	—	SA	SA	—	SA	—	SA	SA	SA	SA
299-W22-69 (UP-3)	A	—	—	—	A	—	A	—	—	A	A	—
299-W22-72 (UP-4)	A	—	—	—	A	—	A	—	A	A	A	A
299-W22-83	SA	—	—	SA	SA	—	SA	SA	SA	SA	SA	SA
299-W22-86 (UP-5)	SA	—	—	SA	SA	SA	SA	SA	—	SA	SA	—
299-W22-87 (UP-11)	A	—	—	—	A	—	A	—	—	A	A	A
299-W22-88 (UP-12)	—	—	—	—	A	—	A	—	—	A	A	A
299-W22-95 ^c	Q/A ^c	—	—	—	Q/A ^c	Q/A ^c	Q/A ^c	—	—	Q/A ^c	Q/A ^c	—
299-W22-96	A	—	—	—	A	A	A	—	—	A	A	—
299-W23-15	A	A	—	—	A	—	—	—	—	A	A	A
299-W23-21	A	—	—	—	A	—	—	—	—	A	A	A

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Table B-1. 200-UP-1 Operable Unit Interim Groundwater Sampling Schedule

Well Name ^a	Volatile Organic Analytes				Anions	Metals ^b	Radionuclides					
	Carbon Tetrachloride	Chloroform	1,4-Dioxane	Trichloroethene	Nitrate	Chromium (total)	Iodine-129	Selenium-79	Strontium-90	Technetium-99	Tritium	Uranium
299-W23-4	A	A	—	A	A	—	—	—	—	—	A	A
299-W26-13	BO	—	—	BO	BO	—	BO	—	—	—	BO	BO
299-W26-14	BE	—	—	BE	BE	—	BE	—	—	BE	BE	BE
699-30-66 (New Well R)	SA	—	—	—	SA	SA	SA	—	—	—	SA	SA
699-32-62	—	—	—	—	BO	BO	BO	—	—	—	BO	—
699-32-72A	—	—	—	BO	BO	—	BO	—	—	—	BO	—
699-32-76 (UP-9)	BO	—	—	—	BO	BO	BO	—	—	—	—	—
699-33-74 (UP-7)	A	—	—	A	A	A	A	—	—	A	A	A
699-33-75 (UP-8)	SA	—	—	SA	SA	SA	SA	—	—	—	SA	SA
699-33-76 (UP-10)	A	—	—	—	A	A	A	—	—	—	—	—
699-34-72 (UP-6)	A	—	A	—	A	A	A	—	A	A	A	A
699-35-66A	BO	—	—	—	BO	BO	BO	—	—	—	BO	—
699-35-78A	A	—	—	—	A	—	—	—	—	—	—	A
699-36-61A	—	—	—	—	BE	BE	BE	—	—	—	BE	—
699-36-70A	A	—	—	—	A	—	A	—	—	A	A	A
699-36-70B (New Well P)	A	—	—	A	A	—	A	—	—	A	A	A

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Table B-1. 200-UP-1 Operable Unit Interim Groundwater Sampling Schedule

Well Name ^a	Volatile Organic Analytes				Anions	Metals ^b	Radionuclides					
	Carbon Tetrachloride	Chloroform	1,4-Dioxane	Trichloroethene	Nitrate	Chromium (total)	Iodine-129	Selenium-79	Strontium-90	Technetium-99	Tritium	Uranium
699-38-65	—	—	—	—	A	—	A	—	—	—	A	—
699-38-68A	BO	—	—	BO	BO	—	BO	—	—	BO	BO	BO
699-38-70B (New Well O)	A	—	—	A	A	—	A	—	—	A	A	A
699-38-70C (New Well N)	A	—	—	—	A	—	A	—	—	A	A	A
699-40-62	—	—	—	—	BO	—	BO	—	—	BO	BO	BO
699-40-65 (New Well S)	A	—	—	—	A	—	A	—	—	—	A	—

a. Temporary well names (prior to drilling) in parentheses.

b. Filtered and unfiltered analyses.

c. Well 299-W22-95 not yet drilled. After it is installed, sample quarterly for one year, then annually thereafter.

A = to be sampled annually

BE = to be sampled every other year (biennially) in even fiscal years

BO = to be sampled every other year (biennially) in odd fiscal years

Q = to be sampled quarterly

SA = to be sampled semiannually

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Appendix C

2

Applicable or Relevant and Appropriate Requirements

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C Applicable or Relevant and Appropriate Requirements

The source for the table provided in this appendix is the *Record of Decision for Interim Remedial Action, Hanford 200 Area Superfund Site, 200-UP-1 Operable Unit* (EPA et al., 2012).

Reference

EPA, Ecology, and DOE, 2012, *Record of Decision for Interim Remedial Action, Hanford 200 Area Superfund Site, 200-UP-1 Operable Unit*, U.S. Environmental Protection Agency, Washington State Department of Ecology, and U.S. Department of Energy, Olympia, Washington.
Available at: <http://www5.hanford.gov/arpir/?content=findpage&AKey=0091413>.

Table 15. Identification of Federal ARARs

ARAR Citation	Relevancy and Category	Requirement	Rationale for Use
<i>Safe Drinking Water Act of 1974 (Public Law 93-523, as amended; 42 USC 300f, et seq.); "National Primary Drinking Water Regulations" (40 CFR 141)</i>			
"Maximum Contaminant Levels for Organic Contaminants," 40 CFR 141.61	ARAR-chemical	Establishes MCLs for drinking water that are designed to protect human health from the potential adverse effects of organic contaminants in drinking water.	The groundwater in the 200-UP-1 OU is not currently used for drinking water. However, Central Plateau groundwater is considered a potential drinking water source. Thus, the substantive requirements in 40 CFR 141.62 for organic, inorganic, and radionuclide constituents are relevant and appropriate, except for I-129, which is waived. MCLs will be achieved through groundwater treatment and MNA.
"Maximum Contaminant Levels for Inorganic Contaminants," 40 CFR 141.62	ARAR-chemical	Establishes MCLs for drinking water that are designed to protect human health from the potential adverse effects of inorganic contaminants in drinking water.	
"Maximum Contaminant Levels for Radionuclides," 40 CFR 141.66	ARAR-chemical	Establishes MCLs for drinking water that are designed to protect human health from the potential adverse effects of radionuclides in drinking water.	
Other Federal ARARs			
<i>Archeological and Historic Preservation Act of 1974,</i> 16 USC 469a-1 – 469a-2(d)	ARAR-location	Provides for the preservation of archaeological and historic data. This act mandates preservation of the data and does not require protection of the actual historical sites.	Archeological and historic sites have been identified within the 200 Area and may be present in areas where remedial action will be taken pursuant to this ROD; therefore, the substantive requirements of this act are applicable to actions that might result in loss of archaeological or historic data
<i>National Historic Preservation Act of 1966,</i> 16 USC 470, Section 106, et seq. "Protection of Historic Properties" (36 CFR 800)	ARAR-location	Requires federal agencies to consider the impacts of their undertaking on historic properties through identification, evaluation, and avoidance and if impact cannot be avoided through minimization and mitigation	Cultural and historic sites have been identified within the 200 Area and may be present in areas where remedial action will be taken pursuant to this ROD; therefore, the substantive requirements of this act are applicable to actions that might disturb these types of sites.
<i>Native American Graves Protection and Repatriation Act of 1990,</i> 25 USC 3001, et seq. "Native American Graves Protection and Repatriation Regulations" (43 CFR 10)	ARAR-location	Establishes federal agency responsibility for discovery of human remains, associated and unassociated funerary objects, sacred objects, and items of cultural patrimony.	Substantive requirements of this act are applicable if remains and sacred objects are found during remediation. The Tribal Nations will be consulted if such items are found during remediation.
<i>Endangered Species Act of 1973,</i>	ARAR-location	Prohibits actions by federal agencies that are	Substantive requirements of this act are applicable if

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ARAR Citation	Relevancy and Category	Requirement	Rationale for Use
Public Law 93-205, as amended; 7 USC Section 136; 16 USC Ch. 1531, et seq. (50 CFR 402, "Interagency Cooperation—Endangered Species Act of 1973, as Amended")		likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of habitat critical to them. Mitigation measures must be applied to actions that occur within critical habitats or surrounding buffer zones of listed species, in order to protect the resource.	threatened or endangered species are identified in areas where RAs will occur or if RAs occur in critical habitats or surrounding buffer zones of listed species.
<i>Migratory Bird Treaty Act of 1918</i> (16 USC 703-712; Ch. 128; 40 Stat. 755), as amended	ARAR-location	Protects all migratory bird species and prevents "take" of protected migratory birds, their young, or their eggs."	Migratory birds occur in the 200 West Area were 200-UP-1 OU remedial activities will take place.

Note: The state of Washington dangerous waste program has been authorized under the Resource Conservation and Recovery Act (RCRA) and WAC 173-303, "Dangerous Waste Regulations" to operate in lieu of federal RCRA hazardous waste regulations.

Table 16. Identification of State ARARs

ARAR Citation	Relevancy and Category	Requirement	Rationale for Use
“Hazardous Waste Cleanup – Model Toxics Control Act” (RCW 70.105D, as amended); “Model Toxics Control Act—Cleanup” (WAC 173-340)			
“Ground Water Cleanup Standards” (WAC 173-340-720)	ARAR-chemical	<p>These groundwater cleanup requirements are ARARs where they are more stringent than federal MCL ARARs.</p> <p>Method B equations (720-1 and 720-2) will be used to calculate groundwater cleanup levels for noncarcinogens and carcinogens, respectively.</p> <p>Requires an adjustment downward of Method B groundwater cleanup levels based on existing state or Federal cleanup standard so that the total excess cancer risk does not exceed 1×10^{-5} and the hazard index does not exceed 1.</p>	The groundwater in the 200-UP-1 OU is not currently used for drinking water. However the 200-UP-1 OU groundwater is considered a potential drinking water source and is considered potable under WAC 173-340-720.
“Public Health and Safety,” “Hazardous Waste Management” (RCW 70.105, as amended); “Dangerous Waste Regulations” (WAC 173-303)			
“Identifying Solid Waste” WAC 173-303-016	ARAR-action	Identifies those materials that are and are not solid wastes.	Substantive requirements of these regulations are applicable because they define how to determine which materials generated in conducting the selected remedial action are solid waste subject to the requirements for solid wastes and to dangerous waste designation requirements.
“Recycling Processes Involving Solid Waste” WAC 173-303-017	ARAR-action	Identifies materials that are and are not solid wastes when recycled.	
“Designation of Dangerous Waste” WAC 173-303-070(3)	ARAR-action	Establishes whether a solid waste is, or is not, a dangerous waste or an extremely hazardous waste.	Substantive requirements of these regulations are applicable to solid wastes generated during the remedial action. Specifically, solid waste that is generated during this remedial action would, if a dangerous waste, be subject to the dangerous waste regulations.
“Excluded Categories of Waste” WAC 173-303-071	ARAR-action	Describes those categories of wastes that are excluded from the requirements of WAC 173-303 (excluding WAC 173-303-050).	This exclusion is applicable to waste from remedial actions in the 200-UP-1 OU, should wastes identified in WAC 173-303-071 be generated.
“Conditional Exclusion of Special Wastes”	ARAR-action	Establishes the conditional exclusion and the management requirements of special wastes,	Substantive requirements of this conditional exclusion are applicable to special wastes generated

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ARAR Citation	Relevancy and Category	Requirement	Rationale for Use
WAC 173-303-073		as defined in WAC 173-303-040.	during the remedial action.
"Requirements for Universal Waste" WAC 173-303-077	ARAR-action	Identifies those wastes exempted from regulation under WAC 173-303-140 and WAC 173-303-170 through 173-303-9906 (excluding WAC 173-303-960). These wastes are subject to regulation under WAC 173-303-573.	Substantive requirements of these regulations are applicable to universal waste generated during the remedial action.
"Recycled, Reclaimed, and Recovered Wastes" WAC 173-303-120 Specific subsections: WAC 173-303-120(3) WAC 173-303-120(5)	ARAR-action	These regulations define the requirements for recycling materials that are solid and dangerous waste. Specifically, WAC 173-303-120(3) provides for the management of certain recyclable materials, including spent refrigerants, antifreeze, and lead-acid batteries. WAC 173-303-120(5) provides for the recycling of used oil.	Substantive requirements of these regulations are applicable to certain materials that might be generated during the remedial action. Eligible recyclable materials can be recycled and/or conditionally excluded from certain dangerous waste requirements.
"Land Disposal Restrictions" WAC 173-303-140	ARAR-action	This regulation establishes state standards for land disposal of dangerous waste and incorporates, by reference, federal land disposal restrictions of 40 CFR 268 that are ARARs for solid waste that is designated as dangerous or mixed waste in accordance with WAC 173-303-070(3).	The substantive requirements of this regulation are applicable to materials generated during the remedial action. Specifically, dangerous/mixed waste that is generated during the remedial action would be subject land disposal restrictions. The offsite treatment, disposal, or management of such waste would be subject to all applicable substantive and procedural laws and regulations, including land disposal restriction requirements.
"Requirements for Generators of Dangerous Waste" WAC 173-303-170	ARAR-action	Establishes the requirements for dangerous waste generators.	Substantive requirements of this regulation are applicable to dangerous waste generated during the remedial action. Specifically, the substantive standards for management of dangerous or mixed waste are ARARs to the management of dangerous waste that will be generated during the remedial action.
"Closure and post-closure" WAC 173-303-610	ARAR-action	Establishes requirements for clean closure of a TSD	The substantive requirements of this regulation are applicable to the 200 West Groundwater Treatment Facility since it treats groundwater that contains dangerous waste and is subject to closure

ARAR Citation	Relevancy and Category	Requirement	Rationale for Use
			requirements of a dangerous waste treatment unit.
“Use and Management of Containers” WAC 173-303-630	ARAR-action	Establishes requirements for dangerous waste facilities that store containers of dangerous waste	The substantive requirements of this regulation are applicable to the 200 West Groundwater Treatment Facility since if the treatment process will result in use of containers that store dangerous waste while awaiting disposal.
“Solid Waste Management—Reduction and Recycling” (RCW 70.95, as amended); “Solid Waste Handling Standards” (WAC 173-350)			
“On-Site Storage, Collection and Transportation Standards,” WAC 173-350-300	ARAR-action	Establishes the requirements for the temporary storage of solid waste in a container onsite and the collecting and transporting of the solid waste.	The substantive requirements of this newly promulgated rule are applicable to the onsite collection and temporary storage of solid wastes for the 200-UP-1 OU remediation activities.
“Water Well Construction” (RCW 18.104, as amended); “Minimum Standards for Construction and Maintenance of Wells” (WAC 173-160)			
“How Shall Each Water Well Be Planned and Constructed?” (WAC 173-160-161)	ARAR-action	Identifies well planning and construction requirements.	The substantive requirements of these regulations are ARARs to actions that include construction and maintenance of wells used for groundwater extraction, monitoring, or injection of treated groundwater. The substantive requirements of WAC 173-160-161, 173-160-171, 173-160-181, 173-160-400, 173-160-420, 173-303-430, 173-160-440, 173-160-450, and 173-160-460 are ARARs to groundwater well construction, monitoring, or injection of treated groundwater or wastes in the 200-UP-1 OU.
“What Are the Requirements for the Location of the Well Site and Access to the Well?” (WAC 173-160-171)	ARAR-action	Identifies the requirements for locating a well.	
“What Are the Requirements for Preserving the Natural Barriers to Ground Water Movement Between Aquifers?” (WAC 173-160-181)	ARAR-action	Identifies the requirements for preserving natural barriers to groundwater movement between aquifers.	
“What Are the Minimum Standards for Resource Protection Wells and Geotechnical Soil Borings?” (WAC 173-160-400)	ARAR-action	Identifies the minimum standards for resource protection wells and geotechnical soil borings.	
“What Are the General Construction Requirements for Resource Protection Wells?” (WAC 173-160-420)	ARAR-action	Identifies the general construction requirements for resource protection wells.	
“What Are the Equipment Cleaning Standards?”	ARAR-action	Identifies the minimum casing standards	

ARAR Citation	Relevancy and Category	Requirement	Rationale for Use
(WAC 173-160-430)			
“What Are the Minimum Casing Standards?” (WAC 173-160-440)	ARAR-action	Identifies the equipment cleaning standards.	
“What Are the Well Sealing Requirements?” (WAC 173-160-450)	ARAR-action	Identifies the well sealing requirements.	
“What Is the Decommissioning Process for Resource Protection Wells?” (WAC 173-160-460)	ARAR-action	Identifies the decommissioning process for resource protection wells.	
“Underground Injection Control” WAC 173-218			
“UIC Well Classification Including Allowed and Prohibited Wells” (WAC 173-218-040)	ARAR-action	Identifies what an injection well is and types of prohibited wells.	The substantive requirements of these regulations are ARARs to actions that discharge liquid effluents to injection wells. WAC 173-218-040(4) allows for injection of treated groundwater into the same formation from where it was drawn as part of a removal or remedial action approved by EPA in accordance with CERCLA.
“Decommissioning of UIC Well” (WAC 173-218-120)	ARAR-action	Identifies requirements for decommissioning of UIC wells.	The substantive requirements of these regulations are ARARs to actions that deal with decommissioning UIC wells.
“Washington Clean Air Act” (RCW 70.94, as amended); “General Regulations for Air Pollution Sources” (WAC 173-400)			
“General Regulations for Air Pollution Sources” (WAC 173-400)	ARAR-action	Defines methods of control to be employed to minimize the release of air contaminants associated with fugitive emissions resulting from materials handling, construction, demolition, or other operations. Emissions are to be minimized through application of best available control technology.	Groundwater remedial actions implemented in the 200 Area pursuant to this ROD provide the potential for emissions subject to these standards because hazardous contaminants detected in 200-UP-1 OU groundwater include covered hazardous air pollutants.

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ARAR Citation	Relevancy and Category	Requirement	Rationale for Use
<p>"General Standards for Maximum Emissions" (WAC 173-400-040)</p> <p>"Emission Standards for Sources Emitting Hazardous Air Pollutants" (WAC 173-400-075)</p>	ARAR-action	<p>Requires all sources of air contaminants to meet emission standards for visible, particulate, fugitive, odors, and hazardous air emissions. Requires use of reasonably available control technology.</p> <p>Establishes national emission standards for hazardous air pollutants. Adopts, by reference, 40 CFR 61, "National Emission Standards for Hazardous Air Pollutants," and appendices.</p>	Substantive requirements of these standards are ARARs to this remedial action when visible, particulate, fugitive, and hazardous air emissions and odors resulting from remedial activities will require assessment and reporting. This requirement is action-specific.
"Washington Clean Air Act" (RCW 70.94, as amended); "Controls for New Sources of Toxic Air Pollutants" (WAC 173-460)			
<p>"Purpose" (WAC 173-460-010)</p> <p>"Applicability" (WAC 173-460-030)</p> <p>"Control Technology Requirements" (WAC 173-460-060)</p> <p>"Ambient Impact Requirement" (WAC 173-460-070)</p> <p>"First Tier Review" (WAC 173-460-080)</p> <p>"Table of ASIL, SQER and de Minimis Emission Values" (WAC 173-460-150)</p> <p>"Second Tier Review" (WAC 173-460-090)</p>	ARAR-action	Requires that new sources of air emissions meet emission requirements identified in this regulation.	Substantive requirements of these standards are ARARs to this remedial action because of the potential for toxic air pollutants to become airborne as a result of remedial activities.
"Washington Clean Air Act" (RCW 70.94, as amended); "Ambient Air Quality Standards and Emission Limits for Radionuclides" (WAC 173-480)			
<p>"General Standards for Maximum Permissible Emissions" (WAC 173-480-050(1))</p>	ARAR-action	All radionuclide emission units are required to meet emission standards. At a minimum all emission units shall meet chapter 246-247 or 246-248 WAC (as applicable) requiring every reasonable effort to maintain radioactive materials in effluents to unrestricted areas, as low as reasonably achievable (ALARA).	Substantive requirements are ARARs when fugitive and diffuse emissions resulting from excavation occur, and related activities will require assessment and reporting. This requirement is action-specific.

ARAR Citation	Relevancy and Category	Requirement	Rationale for Use
"Emission Monitoring and Compliance Procedures" (WAC 173-480-070(2))	ARAR-action	Requires that radionuclide emissions shall be determined by calculating the dose to members of the public at the point of maximum annual air concentration in an unrestricted area where any member of the public may be. This state regulation is as (or more) stringent than the equivalent Federal program requirement.	The substantive requirements of this standard are ARARs to remedial actions involving disturbance or ventilation of radioactively contaminated areas or structures, because airborne radionuclides may be emitted to unrestricted areas where any member of the public may be. This requirement is action-specific.
"Emission Standards for New and Modified Emission Units" (WAC 173-480-060)	ARAR-action	Requires that construction, installation, or establishment of new air emission control units use best available radionuclide control technology.	Hazardous contaminants detected in 200-UP-1 groundwater include radionuclides that could be emitted from air emission control units during remedial actions.
"Nuclear Energy and Radiation" (RCW 70.98, as amended); "Radiation Protection—Air Emissions" (WAC 246-247)			
"National Standards Adopted by Reference for Sources of Radionuclide Emissions" (WAC 246-247-035) (WAC 246-247-035(1)(a)(i) [adopts by reference 40 CFR 61.12, "Compliance with Standards and Maintenance Requirements"])	ARAR-action	Requires the owner or operator of each stationary source of hazardous air pollutants subject to a national emission standard for a hazardous air pollutant to determine compliance with numerical emission limits in accordance with emission tests established in "Emission Tests and Waiver of Emission Tests" (40 CFR 61.13) or as otherwise specified in an individual subpart. Compliance with design, equipment, work practice, or operational standards shall be determined as specified in the individual subpart. Also, maintain and operate the source, including associated equipment for air pollution control, in a manner consistent with good air pollution control practice for minimizing emissions.	Substantive requirements of this standard are ARARs because this remedial action may provide airborne emissions of radioactive particulates. As a result, requirements limiting emissions apply.

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ARAR Citation	Relevancy and Category	Requirement	Rationale for Use
"National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities" (WAC 246-247-035 (1)(a)(ii) [adopts by reference 40 CFR 61.93, "Emission Monitoring and Test Procedures"])	ARAR-action	This regulation incorporates requirements of 40 CFR 61, Subpart H by reference. Radionuclide airborne emissions from the facility shall be controlled so as not to exceed amounts that would cause an exposure greater than 10 mrem/yr effective dose equivalent. This state regulation is as (or more) stringent than the equivalent Federal program requirement.	Substantive requirements of this standard are ARARs because this remedial action may provide airborne emissions of radioactive particulates. As a result, requirements limiting emissions apply. This is a risk-based standard for the purposes of protecting human health and the environment.
"General Standards" (WAC 246-247-040(3) WAC 246-247-040(4))	ARAR-action	Requires that emissions be controlled to ensure ALARA-based and best available control standards are not exceeded.	Substantive requirements of this standard are ARARs because fugitive, diffuse, and point source emissions of radionuclides to the ambient air may result from remedial activities, such as excavation of contaminated soils and operation of exhausters and vacuums, performed during the remedial action. This standard exists to ensure compliance with emission standards.
"Monitoring, Testing and Quality Assurance" (WAC 246-247-075)	ARAR-action	Establishes the monitoring, testing, and quality assurance requirements for radioactive air emissions. Emissions from nonpoint and fugitive sources of airborne radioactive material will be measured. Measurement techniques may include but are not limited to sampling, calculation, smears, or other reasonable method for identifying emissions.	Substantive requirements of this standard are ARARs when fugitive and nonpoint source emissions of radionuclides to the ambient air may result from activities, such as operation of exhausters and vacuums, performed during the 200-UP-1 OU remedial action. This standard exists to ensure compliance with emission standards.

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